

**EPA Superfund
Record of Decision:**

**TYSONS DUMP
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UPPER MERION TWP, PA
09/30/1988**

- * EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SOILS AND WASTES TO A PERMITTED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) LANDFILL.
- * UPGRADING THE EXISTING AIR-STRIPPING FACILITY TO TREAT LEACHATE, SHALLOW GROUNDWATER AND SURFACE RUN-ON ENCOUNTERED DURING EXCAVATION.
- * EXCAVATION AND OFF-SITE DISPOSAL OF CONTAMINATED SEDIMENTS WITHIN THE TRIBUTARY WHICH RECEIVES EFFLUENT FROM THE EXISTING AIR STRIPPER.

FOLLOWING ISSUANCE OF THE ROD, EPA BEGAN REMEDIAL DESIGN FOR THE SELECTED ALTERNATIVE IN JANUARY 1985. THIS DESIGN INCLUDED ADDITIONAL BORINGS THROUGHOUT THE LAGOON AREA TO DEFINE THE VOLUME OF MATERIAL TO BE EXCAVATED. IN AUGUST 1985 THROUGH NOVEMBER 1985 EPA PERFORMED ADDITIONAL BORINGS AND MAGNETOMETER SURVEYS THROUGHOUT THE LAGOON AREA TO BETTER DELINEATE THE AREAS TO BE EXCAVATED.

IN THE FALL OF 1985, CIBA-GEIGY CORPORATION AGREED TO CONDUCT A FURTHER INVESTIGATION OF THE OFF-SITE AREA, THE NEED FOR WHICH WAS DESCRIBED IN THE DECEMBER 1984 EPA ROD. THE OFF-SITE AREA IS DEFINED HERE AS THE AREA OUTSIDE OF THE SECURITY FENCE INCLUDING THE DEEP AQUIFER (BEDROCK AQUIFER). EPA SUBDIVIDED THE OFF-SITE AREA INTO FIVE SUB-AREAS OR "OPERABLE UNITS." THE OFF-SITE OPERABLE UNITS INCLUDED THE FOLLOWING:

- * DEEP AQUIFER (OPERABLE UNIT 1)
- * HILLSIDE AREA (OPERABLE UNIT 2)
- * RAILROAD AREA (OPERABLE UNIT 3)
- * FLOODPLAIN/WETLANDS (OPERABLE UNIT 4)
- * SEEP AREA (OPERABLE UNIT 5)

ON MAY 27, 1986, AN ADMINISTRATIVE CONSENT ORDER (ACO) SIGNED BY EPA AND CIBA-GEIGY CORPORATION WAS ISSUED BY EPA FOR THE OFF-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS).

IN NOVEMBER 1986 CIBA-GEIGY CORPORATION INITIATED AN ON-SITE PILOT STUDY USING AN INNOVATIVE VACUUM EXTRACTION TECHNOLOGY PROCESS. DUE TO ZONING RESTRICTIONS, THE PILOT STUDY OPERATED FOR ONLY A SHORT DURATION (LESS THAN 10 DAYS). HOWEVER, IN MAY 1987, THE PILOT STUDY WAS PERMITTED TO OPERATE FOR MORE THAN THREE WEEKS.

IN DECEMBER 1986, CIBA-GEIGY SUBMITTED A DRAFT OFF-SITE OPERABLE UNIT RI REPORT TO EPA. THIS REPORT INDICATED THAT MUCH OF THE SITE-RELATED CONTAMINATION HAD MIGRATED OFF-SITE AND INTO THE DEEP AQUIFER TOWARD THE SCHUYLKILL RIVER.

ON MARCH 24, 1987, A SECOND ADDENDUM TO THE OFF-SITE RI/FS WORK PLAN WAS SUBMITTED TO EPA BY CIBA-GEIGY CORPORATION. THIS ADDENDUM INCLUDED A DETAILED INVESTIGATION OF THE SCHUYLKILL RIVER AND THE INSTALLATION OF WELLS ON THE NORTH SIDE OF THE RIVER.

IN JUNE AND JULY 1987, FOUR RESPONSIBLE PARTIES, CIBA-GEIGY CORPORATION, SMITH-KLINE BECKMAN, WYETH LABORATORIES, AND ESSEX GROUP SUBMITTED A PROPOSAL TO EPA FOR CLEAN-UP OF THE ON-SITE (LAGOON) AREAS, UPGRADING OF THE LEACHATE COLLECTION SYSTEM AND CLEAN-UP OF THE TRIBUTARY SEDIMENTS. ADDITIONALLY, THE PARTIES PROPOSED TO INITIATE GROUNDWATER REMEDIATION MEASURES SINCE THE INFORMATION CONTAINED IN THE DRAFT OFF-SITE OPERABLE UNITS RI REPORT INDICATED THAT MUCH OF THE CONTAMINATION FORMERLY IN THE LAGOON AREAS WAS NOW IN THE AQUIFER SYSTEM, DOWN GRADIENT OF THE SITE, AND WAS DISCHARGING TO THE SCHUYLKILL RIVER.

THE PARTIES' PROPOSAL WAS BASED ON A COMPREHENSIVE FEASIBILITY STUDY (CFS) SUBMITTED TO THE AGENCY ON JUNE 15, 1987. THE CFS WAS DEVELOPED INDEPENDENTLY BY CIBA-GEIGY CORPORATION AND WAS NOT FORMALLY COMMENTED ON BY EPA. THE CFS INCORPORATED THE RESULTS OF THE INNOVATIVE VACUUM EXTRACTION PROCESS FOR CLEAN-UP OF THE LAGOON SOILS, PRELIMINARY RESULTS OF THE OFF-SITE RI AND ADDITIONAL STUDIES FOR THE INSTALLATION OF GROUNDWATER RECOVERY WELLS. SOME OF THE RESULTS OF THE CFS INDICATED THAT THE CONTAMINANTS IN THE BEDROCK UNDERLYING THE LAGOONS WOULD BE A SOURCE OF CONTINUING CONTAMINATION OF THE BACKFILLED SOIL. THE STUDY RAISED THE POSSIBILITY THAT THE REMEDY SELECTED IN THE ROD WOULD BE OF LIMITED EFFECTIVENESS WITHOUT THE INSTALLATION OF A BARRIER WHICH WOULD LIMIT UPWARD MOVEMENT OF CONTAMINATION FROM THE UNDERLYING BEDROCK.

ON JULY 29, 1987 CIBA-GEIGY CORPORATION SUBMITTED THE FINAL DRAFT OPERABLE UNITS RI REPORT TO EPA. THIS REPORT CONCLUDED THAT MUCH OF THE SITE CONTAMINATION, SPECIFICALLY THE DENSE NON-AQUEOUS PHASE LIQUIDS (DNAPLs), WERE IN THE UNDERLYING BEDROCK AND AQUIFER. THE REPORT ALSO FOUND THAT A DISSOLVED PORTION OF THE

DNAPLS WAS DISCHARGING INTO THE SCHUYLKILL RIVER.

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I. CURRENT SITE STATUS

AS A RESULT OF THE PARTIES PROPOSAL BASED ON THE CFS, EPA NEGOTIATED A PARTIAL CONSENT DECREE WITH CIBA-GEIGY CORPORATION, SMITH KLINE BECKMAN, WYETH LABORATORIES, AND FESSEX GROUP TO IMPLEMENT AN INNOVATIVE TECHNOLOGY VACUUM EXTRACTION THAT WOULD BE MORE EFFECTIVE THAN EXCAVATION IN REMOVING THE CONTAMINATION FROM THE SOILS AND UNDERLYING BEDROCK AT THE ON-SITE AREA. THE PARTIAL CONSENT DECREE WAS SIGNED AND ENTERED ON JUNE 20, 1988. THE VACUUM EXTRACTION PROCESS IS CURRENTLY IN THE CONSTRUCTION PHASE. SEVERAL TEMPORARY VACUUM UNITS HAVE PROVED TO BE VERY SUCCESSFUL IN REDUCING THE CONTAMINANT LEVELS ON-SITE. THE COMPLETE VACUUM EXTRACTION PROCESS IS EXPECTED TO BE ON LINE BY THE END OF OCTOBER, 1988.

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IV. SITE CHARACTERISTICS

A. GEOLOGY/HYDROGEOLOGY

1. SITE GEOLOGY

THREE TYPES OF GEOLOGIC MATERIALS WERE ENCOUNTERED DURING THE REMEDIAL INVESTIGATION (RI): THE OVERBURDEN MATERIALS SOUTH OF THE RAILROAD TRACKS, THE FLOODPLAIN DEPOSITS NORTH OF THE RAILROAD TRACKS, AND THE LOWER MEMBER OF THE STOCKTON FORMATION WHICH UNDERLIES ALL OF THE UNCONSOLIDATED MATERIALS WITHIN THE AREA OF THE INVESTIGATION.

THE OVERBURDEN MATERIALS SOUTH OF THE RAILROAD TRACKS CAN BE DIVIDED INTO THREE TYPES OF MATERIALS: UNDISTURBED COLLUVIAL DEPOSITS, FILL MATERIAL EMPLACED DURING PAST REMEDIAL ACTIVITIES AT THE FORMER LAGOON AREAS, AND CONSTRUCTION DEBRIS AND FILL MATERIAL IN THE SEEP AREA. FIGURE 4-1 SHOWS THE APPROXIMATE DISTRIBUTION OF THE VARIOUS OVERBURDEN MATERIALS. THE UNDISTURBED OVERBURDEN DEPOSITS GENERALLY CONSIST OF A THIN TOPSOIL OVERLYING THE COLLUVIAL DEPOSITS AND WEATHERED BEDROCK. THE TOPSOIL IS AN ORGANIC RICH SILTY SAND. THE COLLUVIAL MATERIALS AND WEATHERED BEDROCK ARE COMPRISED OF SANDY SILTS WITH SOME CLAYS, AND SOME FINE TO COARSE GRAVEL IS FOUND AT DEPTH IN THE UNCONSOLIDATED DEPOSITS. THE THICKNESS OF THE COLLUVIAL MATERIAL VARIES GREATLY OVER THE AREA, FROM THIRTY-ONE AND ONE HALF FEET AT THE EASTERN BORDER OF THE SITE TO ABSENT WHERE BEDROCK OUTCROPS BETWEEN THE EASTERN AND WESTERN SETS OF LAGOONS.

THE OVERBURDEN MATERIALS WITHIN THE FORMER LAGOON AREA WERE PRIMARILY INTERMIXED FILL MATERIALS OF SILTY, GRAVELLY SAND, QUARRY RUBBLE, POSSIBLE RESIDUAL SLUDGES, CONSTRUCTION DEBRIS, AND COLLUVIUM. THESE MATERIALS WERE EMPLACED DURING THE PAST DISPOSAL AND REMEDIAL ACTIVITIES AT THE SITE. TOPSOIL IN THESE AREAS IS THIN AND OFTEN DISCONTINUOUS.

THE OVERBURDEN MATERIALS ENCOUNTERED DURING INSTALLATION OF TESTS PITS IN THE SEEP AREA DURING THE RI INCLUDES A MIXTURE OF DISTURBED AND UNDISTURBED COLLUVIAL DEPOSITS AND CONSTRUCTION DEBRIS. THE CONSTRUCTION DEBRIS IS COMPRISED OF CINDER BLOCKS, WOOD, GLASS, AND PLASTIC MATERIALS. THE GREATEST THICKNESS OF FILL MATERIAL IN THE SEEP AREA IS ABOUT SIX FEET. UNDISTURBED COLLUVIAL DEPOSITS UNDERLIE THE FILL MATERIAL. BEDROCK WAS NOT ENCOUNTERED IN ANY OF THE TEST PITS.

THE SCHUYLKILL RIVER FLOODPLAIN BEGINS AT THE BASE OF THE BEDROCK OUTCROP JUST NORTH OF THE FORMER LAGOON AREA, ESSENTIALLY PARALLEL TO AND IMMEDIATELY SOUTH OF THE CONRAIL TRACKS (FIGURE 4-1). WITH THE EXCEPTION OF THE RAVINE EAST OF THE LAGOONS, THE THICKNESS OF THE FLOODPLAIN DEPOSITS BENEATH THE RAILROAD TRACKS VARIES FROM THREE TO TEN FEET. THE NORTH-SOUTH GEOLOGIC CROSS SECTION IN FIGURE 4-2 SHOWS THAT THE DEPTH TO BEDROCK BENEATH THE RAILROAD TRACKS DROPS SHARPLY FROM THREE TO TEN FEET AT THE BASE OF THE EMBANKMENT SOUTH OF THE RAILROAD TRACKS TO GREATER THAN TWENTY FEET ON THE NORTH SIDE OF THE RAILROAD TRACKS.

FLOODPLAIN DEPOSITS UNDERLYING THE BALLAST ARE COMPRISED OF INTERBEDDED SILTY, SANDY CLAY, WHITE COARSE GRAVEL, AND GRAVEL SIZED CLASTS OF WEATHERED ARKOSIC SANDSTONE. IT APPEARS THAT MATERIALS IN THIS AREA ACTUALLY REPRESENT A TRANSITION BETWEEN THE COLLUVIAL DEPOSITS ORIGINATING FROM THE STEEP HILLSIDE AND THE FLOODPLAIN DEPOSITS. THE FLOODPLAIN DEPOSITS NORTH OF THE RAILROAD TRACKS CAN BE DIVIDED INTO THREE SUB-UNITS AS FOLLOWS:

- * THE UPPER ONE TO TWO FEET OF ORGANIC RICH SILTY CLAY.

- * TEN TO FIFTEEN FEET OF BROWNISH RED SANDY CLAYS, SOMETIMES MOTTLED WITH SOME SILT, TRACE GRAVEL AND COBBLES.

- * A BASAL SAND AND GRAVEL UNIT WITH SOME COBBLES WHICH LIES ON TOP OF BEDROCK. THIS UNIT IS APPROXIMATELY TEN FEET THICK AT THE RIVER, BUT PINCHES OUT TO THE SOUTH UNTIL IT IS ABSENT AT THE RAILROAD TRACKS.

THE LOWER MEMBER OF THE STOCKTON FORMATION BENEATH THE SITE CAN BE DIVIDED INTO FOUR LITHOLOGIC UNITS, EACH OF WHICH IS HIGHLY VARIABLE IN THICKNESS. THESE UNITS, FROM SHALLOWEST TO DEEPEST, INCLUDE:

- * BROWNISH-RED ARKOSIC SANDSTONE, DARK TO LIGHT BROWNISH-RED, MEDIUM TO COARSE GRAINED, ARKOSIC SANDSTONE, WITH TRACE BIOTITE AND QUARTZ COBBLES; THE AVERAGE THICKNESS IS TWENTY FEET.
- * LIGHT GREY GREEN ARKOSIC SANDSTONE, LIGHT GREY-GREEN ARKOSIC SANDSTONE WITH SOME DARK GREEN FINE TO MEDIUM GRAINED ARKOSIC SANDSTONE, WITH TRACE TO LITTLE BIOTITE AND TRACE OLIVE GREEN MEDIUM GRAINED ARKOSIC SANDSTONE; THE AVERAGE THICKNESS IS SEVENTY-FIVE FEET.
- * RED SHALE, DARK RED SILTY SHALE WITH A TRACE BIOTITE, TYPICALLY FIVE TO TEN FEET THICK.
- * DARK GREEN ARKOSIC SANDSTONE, DARK GREEN FINE TO MEDIUM GRAINED ARKOSIC-SUBARKOSIC SANDSTONE, TRACE BIOTITE, LITTLE TO SOME LIGHT GREY GREEN MEDIUM TO COARSE GRAINED SANDSTONE, TRACE BIOTITE. THIS BASAL UNIT WAS FOUND TO BE AT LEAST FORTY FEET THICK.

IN GENERAL, AS SHOWN ON THE GEOLOGIC CROSS-SECTIONS, THE LIGHT GREY GREEN AND DARK GREY-GREEN ARKOSIC SANDSTONES ARE THE PREDOMINANT LITHOLOGIES. THE RED SHALE UNIT WAS ENCOUNTERED IN THE TRANSITIONAL ZONE BETWEEN THE TWO GREEN SANDSTONE UNITS AT CERTAIN LOCATIONS.

2. HYDROGEOLOGY

A. GROUNDWATER

GROUNDWATER AT THE SITE OCCURS IN TWO PRINCIPAL FLOW SYSTEMS: A LOCAL SYSTEM IN THE UNCONSOLIDATED DEPOSITS OVERLYING THE BEDROCK AND A REGIONAL SYSTEM IN THE FRACTURES, JOINTS AND BEDDING PLANES OF THE UNDERLYING BEDROCK. THE BASIC HYDROGEOLOGIC CHARACTERISTICS OF EACH FLOW SYSTEM ARE AS FOLLOWS:

1. UNCONSOLIDATED DEPOSIT

THE UNCONSOLIDATED MATERIALS THAT OVERLIE BEDROCK SOUTH OF THE RAILROAD TRACKS ARE SEPARATED FROM THE RAILROAD BALLAST AND FLOODPLAIN DEPOSITS TO THE NORTH BY A SIGNIFICANT PORTION OF BEDROCK (FIGURES 4-1 AND 4-2).

SOUTH OF THE RAILROAD TRACKS, UNCONSOLIDATED MATERIALS SURROUND AND UNDERLIE THE FORMER LAGOONS BETWEEN SEVERAL BEDROCK HIGHS (OUTCROPS). IN THE COURSE OF THE OFF-SITE OPERABLE UNIT RI, DEPTH TO WATER MEASUREMENTS HAVE SHOWN THAT SOME OF EPA'S MONITORING WELLS COMPLETED IN THESE MATERIALS WERE DRY FOR AT LEAST SOME PORTION OF THE INVESTIGATION. IT IS BELIEVED THAT THE OCCURRENCE OF THE WATER FOUND IN THESE MATERIALS IS ACTUALLY "PERCHED WATER" WHICH IS PONDED ON LOW PERMEABILITY TAR-LIKE MATERIALS LEFT ON THE BOTTOM OF THE FORMER LAGOONS AFTER CLOSURE. THIS WATER IS NOT PERENNIAL, BUT WHEN PRESENT IT SLOWLY PERCOLATES INTO THE FRACTURED BEDROCK BENEATH THE LAGOONS. THE TEMPORARILY PERCHED GROUNDWATER WOULD NOT BE CAPABLE OF YIELDING ANY SIGNIFICANT AMOUNT OF WATER ON A SUSTAINED BASIS TO WELLS OR SPRINGS.

THE OCCURRENCE OF GROUNDWATER IN THE FLOODPLAIN DEPOSITS IS ATTRIBUTED TO THE ZONE OF ENHANCED PERMEABILITY PROVIDED BY THE LAYER OF SANDS AND GRAVELS AT THE BASE OF THE FLOODPLAIN DEPOSITS. THE GROUNDWATER IN THE FLOODPLAIN DEPOSITS IS RECHARGED BY INFILTRATION OF SURFACE RUNOFF AND GROUNDWATER RECHARGE FROM THE BEDROCK AQUIFER.

SURFACE RUNOFF FROM THE SOUTH ENTERS A SERIES OF PONDS LOCATED ON THE FLOODPLAIN DEPOSITS NORTH OF THE RAILROAD TRACKS. THESE PONDS ARE CONSIDERED TO BE "SEASONAL" BECAUSE THEY WERE DRY DURING A PERIOD OF MINIMAL PRECIPITATION BETWEEN MID-JUNE AND LATE JULY, 1986. THE OCCURRENCE OF THE PONDS IS DUE TO THE LOW PERMEABILITY OF THE SILTS AND CLAYS IN THE UPPER PORTION OF THE FLOODPLAIN DEPOSITS AND SEASONALLY HIGH

PRECIPITATION. IT IS BELIEVED THAT THE GROUNDWATER IN THE FLOODPLAIN DEPOSITS RECEIVED RECHARGE AS VERTICAL LEAKAGE FROM THE PONDS, AND THAT WATER ORIGINATING FROM THESE PONDS ALSO DRAINS TO THE SCHUYLKILL RIVER THROUGH INTERMITTENT STREAMS.

2. BEDROCK AQUIFER

THE BEDROCK AQUIFER AT THE TYSON'S SITE IS THE LOWER MEMBER OF THE STOCKTON FORMATION. RECHARGE TO THE BEDROCK AQUIFER OCCURS IN THE AREAS SOUTH OF THE SITE WHERE THE LOWER MEMBER IS EXPOSED OR CLOSE TO THE SURFACE. DURING THE COURSE OF MONITORING WELL INSTALLATION, AN ATTEMPT WAS MADE TO COMPLETE WELLS IN THREE SEPARATE ZONES IN THE BEDROCK AQUIFER. THESE ZONES ARE REFERRED TO AS THE SHALLOW, INTERMEDIATE, AND DEEP ZONES. THE RATIONALE FOR MONITORING A SPECIFIC INTERVAL AT A SPECIFIC WELL LOCATION WAS BASED PRIMARILY ON LOCAL STRATIGRAPHIC CORRELATIONS WITHIN THE LOWER MEMBER AND, SECONDLY, ON THE RELATIVE DEPTH OF OTHER MONITORING WELLS INSTALLED AT THE SITE. SHALLOW ZONE WELLS WERE INSTALLED APPROXIMATELY 30 TO 100 FEET BELOW GROUND SURFACE IN THE BROWNISH RED ARKOSIC SANDSTONE THAT OCCURS NEAR THE SURFACE. THE INTERMEDIATE MONITORING WELLS WERE INSTALLED 75 TO 163 FEET BELOW THE LAND SURFACE AND WERE GENERALLY COMPLETED IN THE LIGHT GREY-GREEN ARKOSIC SANDSTONE. THE INTERMEDIATE WELLS ON OCCASION WERE ALSO INSTALLED WITHIN THE THIN RED SHALE WHICH MARKED THE TRANSITION ZONE BETWEEN THE DOMINATING GREEN SANDSTONE. DEEP ZONE MONITORING WELLS WERE INSTALLED 115 TO 223 FEET BELOW THE SURFACE. LITHOLOGIC DESCRIPTION OF THE DEEP ZONE VARIED FROM A DARK GREEN TO LIGHT GREEN ARKOSIC SANDSTONE.

BOTH PRIMARY AND SECONDARY PERMEABILITY ARE APPARENT IN ALL THREE ZONES MONITORED IN THE BEDROCK AQUIFER. PRIMARY PERMEABILITY IS CONTRIBUTED FROM THE INTERGRANULAR SPACE BETWEEN GRAINS OF MATERIAL COMPRISING THE MATRIX OF THE BEDROCK. PRIMARY PERMEABILITY IS VARIABLE DEPENDING ON THE COMPETENCY OF THE MATRIX BETWEEN THE COARSER GRAINS. THE MATRIX EXPERIENCES VARIABLE DEGREES OF WEATHERING OBSERVED AT THE SITE OUTCROPS AND IN CORES OBTAINED DURING PREVIOUS INVESTIGATIONS. HIGHLY WEATHERED PORTIONS OF THE AQUIFER PROVIDE GREATER PRIMARY PERMEABILITY DUE TO THE DECOMPOSITION AND REMOVAL OF THE MATRIX. IN LESS WEATHERED INTERVALS, THE ARGILLACEOUS MATRIX FILLS THE SPACE BETWEEN COARSE GRAINED MATERIAL, THUS REDUCING PERMEABILITY.

SECONDARY PERMEABILITY IS CONTRIBUTED BY DISCONTINUITIES SUCH AS JOINTS, FRACTURES, FAULTS, AND WEATHERED BEDDING PLANES. THE OCCURRENCE OF SIGNIFICANT ZONES OF ENHANCED SECONDARY PERMEABILITY IS REPRESENTED BY THE FRACTURE TRACES SHOWN ON FIGURE 4-3. THE FRACTURE TRACES ARE INDICATIVE OF VERTICAL PLANES OF FRACTURE CONCENTRATION. THESE PLANES ACT AS CONDUITS FOR GROUNDWATER FLOW AND REPRESENT PREFERRED PATHS FOR THE MIGRATION OF CONTAMINANTS IN GROUNDWATER.

3. HORIZONTAL AND VERTICAL COMPONENTS OF GROUNDWATER FLOW

THE GROUNDWATER CONFIGURATION IN THE SHALLOW UNCONSOLIDATED DEPOSITS OF THE ON-SITE AND FLOODPLAIN AREAS IS SHOWN IN FIGURE 4-4. IN GENERAL, THE SHALLOW GROUNDWATER CONFIGURATION IS A SUBDUED REFLECTION OF THE SURFACE TOPOGRAPHY WITH GROUNDWATER FLOWING NORTH TOWARDS THE SCHUYLKILL RIVER. ON-SITE, THE WATER TABLE CONTOURS MIMIC THE SURFACE OF THE QUARRY FLOOR. A DEPRESSION OCCURS IN THE EASTERN LAGOON AREA WHERE THE FILL MATERIALS ARE BEING DRAINED BY THE UNDERLYING FRACTURED BEDROCK. STEEP HYDRAULIC GRADIENTS OCCUR SOUTH OF THE TRACKS IN THE NEAR SURFACE BEDROCK WHILE GENTLER HYDRAULIC GRADIENTS OCCUR NORTH OF THE TRACKS IN THE FLOODPLAIN.

PIEZOMETRIC SURFACE MAPS, ILLUSTRATED IN FIGURES 4-5 TO 4-7, REFLECT GROUNDWATER CONDITIONS IN THE SHALLOW INTERMEDIATE AND DEEP ZONES OF THE BEDROCK AQUIFERS. WITHIN THE SHALLOW ZONE, THE PIEZOMETRIC SURFACE EXHIBITS A REFLECTION OF THE SURFACE TOPOGRAPHY WITH A GENTLY MOUNDING IN THE CENTER OF THE SITE. FLOW IS NORTH TOWARDS THE RIVER WITH HYDRAULIC GRADIENT RANGING FROM 0.035 TO 0.047 (DIMENSIONLESS).

THE INTERMEDIATE PIEZOMETRIC SURFACE MAP IS CHARACTERIZED BY AN ELONGATED MOUND ORIENTED NORTHEAST IN THE CENTER OF THE SITE. THIS MOUND EXTENDS FROM THE ON-SITE AREA TO THE SCHUYLKILL RIVER. GROUNDWATER FLOW ALONG THE FLANKS OF THE MOUND IS RADIAL TOWARD THE RIVER WITH HYDRAULIC GRADIENTS RANGING FROM 0.035 TO 0.04 (DIMENSIONLESS).

ALTHOUGH LESS DEFINED, GROUNDWATER MOUNDING IN THE CENTER OF THE SITE IS EVIDENT WITHIN THE DEEP AQUIFER AND THE DIRECTION OF GROUNDWATER FLOW IS SIMILAR TO THE INTERMEDIATE ZONE, TOWARDS THE SCHUYLKILL RIVER. HYDRAULIC GRADIENTS ARE SOMEWHAT GREATER THAN THE INTERMEDIATE, RANGING FROM 0.35 TO 0.05 (DIMENSION).

WATER LEVEL ELEVATIONS TO DETERMINE VERTICAL COMPONENTS OF GROUNDWATER FLOW INDICATE AN UPWARD FLOW GRADIENT IN THE BEDROCK AQUIFER. THIS UPWARD GRADIENT REPRESENTS THE DISCHARGE OF A REGIONAL GROUNDWATER FLOW SYSTEM TO THE SCHUYLKILL RIVER.

4. RELATIONSHIP WITH THE SCHUYLKILL RIVER

THE RELATIONSHIP OF THE SCHUYLKILL RIVER TO THE SITE'S HYDROGEOLOGY IS IMPORTANT SINCE UPWARD VERTICAL FLOW GRADIENTS WERE DETERMINED AT CERTAIN WELL NESTS ALONG THE RIVER. THIS INDICATED THAT GROUNDWATER WAS DISCHARGING TO THE RIVER. HYDROSTATIC LEVELS AT THESE WELL LOCATIONS RANGED FROM 2.41 (IN THE SHALLOW WELL ZONE) TO OVER 20 FEET (IN THE DEEPER ZONES) HIGHER THAN THE WATER LEVEL ELEVATION OF THE RIVER. ALTHOUGH WATER LEVELS AT TWO WELL NESTS LOCATED ALONG THE RIVER BANK IN THE IN THE EASTERN PORTION OF THE SITE, EXHIBITED SLIGHT DOWNWARD GRADIENTS, THE SHALLOW ZONE LEVEL STILL INDICATE DISCHARGE TO THE RIVER.

IN SUMMARY, THE UPWARD GROUNDWATER FLOW GRADIENTS DETERMINED AT MOST WELL NESTS LONG THE RIVER BANK ARE INDICATIVE OF A GROUNDWATER DISCHARGE ZONE. ALL OF THE PIEZOMETERS INSTALLED ALONG THE SOUTHERN RIVER BANK SHOW AN UPWARD GRADIENT. ONLY THE TWO DEEPER ZONE INSTALLATIONS OF WELL NESTS EXHIBIT DOWNWARD HYDRAULIC HEADS ALONG THE RIVER BANK.

B. EXTENT OF CONTAMINATION

1. OPERABLE UNIT - BEDROCK AQUIFER

A. OCCURRENCE AND BEHAVIOR OF DENSE NON-AQUEOUS PHASE LIQUID (DNAPL) IN THE BEDROCK AQUIFER

THE LAGOONS USED FOR THE DISPOSAL OF LIQUID WASTES WERE CONSTRUCTED ON A BEDROCK TERRACE SOUTH OF THE RAILROAD TRACKS. THE LOCATION AND CONFIGURATION OF THE LAGOONS WAS LIKELY DICTATED BY THE LOCALLY VARIABLE RIPPABILITY OF WEATHERED BEDROCK ON THE TERRACE. BOTH WEATHERING AND RIPPABILITY ARE RELATED TO THE AMOUNT OF FRACTURING AT A SPECIFIC LOCATION. THE LAGOONS WOULD HAVE BEEN CONSTRUCTED IN AREAS WITH A LOCALLY INCREASED AMOUNT OF FRACTURING. WHEN THE LIQUID WASTES WERE DISPOSED IN THE LAGOONS, THEY RAPIDLY MOVED DOWNWARD THROUGH THE FRACTURES. IT HAS BEEN ESTABLISHED THAT A PROPORTION OF THE LIQUID WASTE EXISTS IN THE FORM OF A DNAPL.

THREE SAMPLES OF THE DNAPL WERE COLLECTED TO CHARACTERIZE ITS CHEMICAL PROPERTIES. THE RESULTS ARE PRESENTED ON TABLE 1. 1,2,3-TRICHLOROPROPANE, WAS DETERMINED TO BE 2.0 PERCENT BY WEIGHT AND 73.0 PERCENT BY WEIGHT IN WELLS 3-1 AND 8-1, RESPECTIVELY. THE OTHER COMPOUNDS FOUND IN THESE SAMPLES WERE XYLENE, ETHYLBENZENE AND TOLUENE. UNIDENTIFIABLE PETROLEUM DISTILLATES CONSTITUTED 20 PERCENT OF THE SAMPLE AT 8-1 AND ABOUT 521 PERCENT OF THE SAMPLE FROM WELL 3-1.

GROUNDWATER FLOW PATTERNS IN THE DEEP AQUIFER WILL HAVE NO EFFECT ON THE MOVEMENT OF DNAPL THROUGH THE BEDROCK. UNDER CONDITIONS WHERE HYDRAULIC GRADIENTS ARE UPWARD SUCH AS EXIST NEAR THE SCHUYLKILL RIVER, UPWARD MOVEMENT OF DNAPL INTO THE RIVER CAN ONLY OCCUR WHEN THE UPWARD HYDRAULIC GRADIENT IS SUFFICIENTLY LARGE TO COUNTERACT THE DOWNWARD FORCE DUE TO THE DENSITY OF THE DNAPL.

DNAPL WAS MEASURED IN THE BOTTOM OF MANY WELLS AND THE RANGE OF MEASURED THICKNESSES IS REPRESENTED ON FIGURE 4-8. THE RANGES GIVEN DO NOT REPRESENT THE VOLUME OF DNAPL IN THE FORMATION, BUT INDICATE DNAPL ACCUMULATION IN THE BOREHOLE.

* THE BALANCE OF THE SAMPLE COMPOSITION WERE COMPOUNDS ELUTING LATER THAN XYLENES, BUT NOT IN AN ELUTION PATTERN IDENTIFIABLE AS PETROLEUM DISTILLATES.

** THE BALANCE OF SAMPLE COMPOSITION WAS TYPICAL OF UNIDENTIFIED PETROLEUM DISTILLATES. PETROLEUM DISTILLATES CAN BE IDENTIFIED AS A GENERAL CLASS OF COMPOUNDS BECAUSE OF THE CHARACTERISTIC HYDROCARBON ENVELOPE THAT IS OBTAINED DURING GAS CHROMATOGRAPHIC ANALYSIS OF SAMPLES CONTAINING THESE ANALITIES.

FIGURE 4-9 IS A GENERALIZED DIAGRAM ILLUSTRATING THE PATHWAY OF MIGRATION OF DNAPL AND RESULTANT CONTAMINATION F GROUNDWATER IN AN AQUIFER. AS THE DNAPL SINKS, PART OF IT BECOMES ENTRAPPED IN THE SPACES PROVIDED BY PRIMARY AND SECONDARY POROSITY. IN THE UNSATURATED VADOSE ZONE, ABOVE THE WATER TABLE, THE ENTRAPPED DNAPL OCCURS IN AVAILABLE SPACES WITH AIR AND WATER. AS DNAPL CONTINUES TO SINK BELOW THE WATER TABLE, ENTRAPPED DNAPL OCCURS IN AVAILABLE SPACE WITH GROUNDWATER ONLY. THE DNAPL SINKS UNTIL IT REACHES A SURFACE OF RELATIVELY LOW PERMEABILITY. HERE THE DNAPL WILL ACCUMULATE AND EITHER POOL OR MOVE DOWNGRADIENT ALONG THE SURFACE. AS DNAPL ACCUMULATES, ALL AVAILABLE SPACE BECOMES SATURATED WITH THE DNAPL, DISPLACING ALL GROUNDWATER.

B. DNAPL DISSOLUTION IN GROUNDWATER

ENTRAPPED DNAPLS PROVIDE A CONTINUING SUPPLY OF DISSOLVED ORGANIC CONSTITUENTS TO FURTHER CONTAMINATE THE AQUIFER. ANY GROUNDWATER THAT COMES IN CONTACT WITH THE DNAPL BECOMES CONTAMINATED WITH ITS DISSOLVED CONSTITUENTS. ONCE THE DNAPL HAS PASSED THROUGH THE AQUIFER, GROUNDWATER COMES IN CONTACT WITH ENTRAPPED DNAPL ALONG THE ENTIRE PATHWAY OF DNAPL MOVEMENT: PERCOLATION FROM THE SURFACE IS CONTAMINATED BY DNAPL ENTRAPPED IN THE VADOSE ZONE; GROUNDWATER MOVING IN THE AQUIFER IS CONTAMINATED BY DNAPL ENTRAPPED IN THE AQUIFER, ABOVE ACCUMULATED DNAPL; AND, GROUNDWATER MOVING ACROSS THE SURFACE OF AN ACCUMULATED DNAPL BECOMES CONTAMINATED. THE ULTIMATE CONCENTRATION OF DISSOLVED CONSTITUENTS IS DETERMINED BY SEVERAL GEOCHEMICAL FACTORS WITH LIMIT THE SOLUBILITY OF THE CONSTITUENT IN GROUNDWATER.

C. GROUNDWATER QUALITY

IN ALL WELLS, 1,2,3-TRICHLOROPROPANE WAS THE ORGANIC COMPOUND FOUND MOST FREQUENTLY AND AT THE HIGHEST CONCENTRATION. OTHER VOLATILE ORGANIC COMPOUNDS COMMONLY DETECTED AT ELEVATED CONCENTRATIONS INCLUDE: TOTAL XYLENES, TOLUENE, AND CIS-1,3DICHLOROPROPENE. SINCE 1,2,3-TRICHLOROPROPANE WAS THE MOST COMMONLY DETECTED COMPOUND IN THE GROUNDWATER SAMPLES AND THE MAJOR COMPONENT OF THE DNAPL, IT SERVES A GOOD TRACER FOR DETERMINING CONTAMINANT MIGRATION OF SITE-RELATED COMPOUNDS. ISOCONCENTRATION MAPS, FIGURES 10 THROUGH 12 SHOW THE DISTRIBUTION OF 1,2,3-TRICHLOROPROPANE IN THE BEDROCK MONITORING WELLS. THESE MAPS HAVE BEEN DEVELOPED USING THE CONCENTRATION OF THE COMPOUNDS DETECTED IN THE GROUNDWATER AND KNOWLEDGE OF THE SITE HYDROGEOLOGIC CONDITIONS. THE DISTRIBUTION OF 1,2, 3-TRICHLOROPROPANE, AS SHOWN BY FIGURES 10 THROUGH 12 INDICATES THAT THE MOVEMENT OF THIS COMPOUND (AND, THEREFORE, THE CONTAMINANT PLUME) IS IN TWO DOMINANT DIRECTIONS:

- * DIRECTLY DOWN DIP (NORTHWEST) OF THE FORMER LAGOONS, AND
- * ALONG A ZONE OF CONCENTRATED FRACTURING TO THE NORTH AND NORTHEAST OF THE EASTERN LAGOON AREA.

THE MOVEMENT OF THE PLUMES IN THESE DIRECTIONS WOULD BE EXPECTED GIVEN THE SITE'S GEOLOGY, THE PHYSICAL NATURE OF THE DNAPL, AND THE DOWN DIP MOVEMENT OF THE DNAPL ALONG WEATHERED BEDDING PLANES AND THROUGH FRACTURE ZONES.

TOTAL XYLENES AND TOLUENE WERE THE SECOND AND THIRD MOST ABUNDANT ORGANIC COMPOUNDS DETECTED IN ALL WELLS. THEIR OVERALL DISTRIBUTION WAS SIMILAR TO 1,2,3-TRICHLOROPROPANE.

2. OPERABLE UNIT 2 - HILLSIDE AREA

A TOTAL OF NINE SOIL SAMPLES WERE TAKEN FROM THE HILLSIDE AREA. DURING THE RI, THE HILLSIDE AREA WAS DEFINED AS THAT AREA FROM JUST NORTH OF THE SECURITY FENCE TO THE BASE OF THE BEDROCK OUTCROP WHICH SEPARATES THE FORMER LAGOON AREA FROM THE RAILROAD TRACKS. THE PURPOSE OF THIS EFFORT WAS TO DETERMINE IF THE SOILS IN THESE AREAS HAD BEEN AFFECTED BY OVERFLOW FROM THE FORMER LAGOONS OR DISCHARGE FROM THE BEDROCK OUTCROP OBSERVED ON THE HILLSIDE. THE HILLSIDE AREA IS COMPRISED OF SOILS OF THE LANSDALE SERIES. BECAUSE OF THE STEEPNESS OF THE HILLSIDE (15-35 PERCENT SLOPE), THESE SOILS ARE SEVERELY ERODED. THE EROSION TENDS TO CONCENTRATE SANDSTONE PEBBLES AND FRAGMENTS ON THE SOIL SURFACE.

ORGANIC COMPOUNDS

ORGANIC COMPOUNDS WERE DETECTED IN FOUR OF THE NINE HILLSIDE SOIL SAMPLES (TABLE 4-17). SAMPLE SS017 CONTAINED THREE VOLATILE COMPOUNDS INCLUDING TRICHLOROETHENE (0.02 MG/KG), TETRACHLOROETHENE (0.03 MG/KG), AND 1,2,3-TRICHLOROPROPANE (0.20 MG/KG). ONE SEMI-VOLATILE COMPOUND, 2,4-DIMETHYLPHENOL, WAS ALSO DETECTED IN SAMPLE SS017 AT 0.63 MG/KG. SAMPLE SS020 CONTAINED 1,2,3-TRICHLOROPROPANE AT 0.25 MG/KG, WHICH WAS THE HIGHEST LEVEL DETECTED IN THE HILLSIDE SOILS, AND NAPHTHALENE AT 0.23 MG/KG. SAMPLE SS023 CONTAINED 0.0085 MG/KG OF TETRACHLOREOTHENE. SAMPLE SS024 CONTAINED SEVEN SEMI-VOLATILE COMPOUNDS INCLUDING 5 POLYNUCLEAR AROMATIC HYDROCARBONS PAHS WITH A TOTAL PAH CONCENTRATION OF 2.7 MG/KG AND TWO SUBSTITUTED PHENOLS WITH A TOTAL CONCENTRATION OF 1.15 MG/KG.

INORGANIC CONSTITUENTS

CONCENTRATIONS OF INORGANIC CONSTITUENTS IN SOIL SAMPLES TAKEN FROM THE HILLSIDE AREA ARE ALSO PRESENTED IN TABLE 4-17. WITH THE EXCEPTIONS OF COPPER IN SAMPLE SS022 AND SELENIUM IN SAMPLE SS020, ALL CONSTITUENTS WERE FOUND TO BE WELL WITHIN OR BELOW THE REPORTED TYPICAL RANGES OF INORGANIC CONSTITUENTS IN EASTERN UNITED STATES SOILS. ELEVATED LEVELS OF THESE CONSTITUENTS WERE FOUND IN ONLY TWO OF THE SAMPLES OBTAINED FROM THE HILLSIDE AREA. CONSEQUENTLY, THIS CONTAMINATION IS BELIEVED TO BE LOCALIZED. THE LOCALIZED NATURE OF THE ELEVATED CONCENTRATIONS WHEN COMBINED WITH THE FACT THAT BOTH COPPER AND SELENIUM CAN BE STRONGLY COMPLEXED

IN A NON-SOLUBLE ORGANIC FORM, SUGGESTS THAT THESE CONSTITUENTS PRESENT MINIMAL MIGRATION POTENTIAL.

B. OPERABLE UNIT 3 - SEEP AREA

THE SEEP AREA IS SMALL AREA (APPROXIMATELY 150 BY 100 FEET) LOCATED WEST OF THE FORMER LAGOON AREA. WHEN THE LAGOONS WERE ACTIVE, THIS AREA WAS A GENTLY SLOPING HILLSIDE. DURING THE CONSTRUCTION OF THE NEARBY RESIDENTIAL SUBDIVISION, SOILS FROM THE AREA WERE REPORTEDLY EXCAVATED AND USED AS CONSTRUCTION FILL. SOMETIME AFTER THE SOIL WAS REMOVED, THE EPA WAS NOTIFIED OF SEEPAGE EMANATING FROM THE AREA. ACCORDING TO THE RESULTS, THIS SAMPLE DID NOT CONTAIN ANY CONTAMINANTS. A SAMPLE OF THE SEEPAGE WAS COLLECTED, AND THE AREA BACKFILLED. BACKFILLING ELIMINATED OBVIOUS SEEPAGE AND ALSO CREATED A RELATIVELY HETEROGENEOUS SOIL IN TERMS OF BOTH PHYSICAL AND CHEMICAL PROPERTIES.

SOIL DEVELOPING IN THE AREA WERE OF THE BOWMANVILLE SERIES, DERIVED FROM MATERIALS WASHED FROM SURROUNDING UPLANDS UNDERLAIN BY SHALE AND SANDSTONE. THESE SOILS TYPICALLY EXHIBIT THIN, MOTTLED, REDDISH BROWN SILTY SURFACE HORIZONS, AND WEAK-RED, EXTENSIVELY MOTTLED, SILTY SUBSOILS. SIXTEEN SOIL SAMPLES WERE COLLECTED FROM LOCATIONS WITHIN THE SEEP AREA.

ORGANIC COMPOUNDS

RESULTS OF THE HSL ORGANIC AND INORGANIC ANALYSES ARE PRESENT IN TABLE 4-19. THE OCCURRENCE OF VOLATILE COMPOUNDS IN ALL SAMPLES WAS QUALITATIVELY QUESTIONABLE. SAMPLES SS013 AND SS011, COLLECTED AT DEPTHS OF 3.3 AND 9 FEET, RESPECTIVELY, WERE THE ONLY SOIL SAMPLES IN WHICH PAHS WERE DETECTED. SEVEN COMPOUNDS RANGING IN CONCENTRATION FROM 0.3 TO 1.1 MG/KG WITH A TOTAL PAH CONCENTRATION OF 5.63 MG/KG WERE DETECTED IN SAMPLE SS013. TWO COMPOUNDS WITH A TOTAL PAH CONCENTRATION OF 0.4 MG/KG WERE DETECTED IN SAMPLE SS011. AS DISCUSSED IN SECTION 4.7 MG/KG THESE PAH COMPOUNDS DID NOT ORIGINATE FROM THE FORMER LAGOON AREA.

THE PRESENCE OF THE PESTICIDE DDT WAS TENTATIVELY IDENTIFIED AND THE BREAKDOWN PRODUCT DDD WAS CONFIRMED IN SAMPLE SS011. TOTAL DDT AND DDD CONCENTRATION WAS 0.94 MG/KG OF WHICH 0.88 MG/KG WAS DDT. DDT CONCENTRATION IN THIS SAMPLE WAS THE HIGHEST LEVEL OF DDT DETECTED IN ANY OF THE SOIL SAMPLES.

INORGANIC CONSTITUENTS

PHYSICALLY, SOILS OF THE SEEP AREA EXHIBITED SIGNS OF DISTURBANCE AND FILL, E.G., THE PRESENCE OF CINDER BLOCKS, WOOD FRAGMENTS, BLACK PLASTIC, ETC. CHEMICALLY, WIDE VARIATIONS IN THE CONCENTRATION OF INORGANIC CONSTITUENTS WERE FOUND. HOWEVER, NO DEPTH RELATIONSHIP OF THE CONSTITUENTS WAS DETECTED NOR WAS THERE A RELATIONSHIP BETWEEN EXCAVATIONS SEPARATED BY ONLY A FEW FEET. HIGHEST CONCENTRATIONS OF CHROMIUM, COBALT, COPPER, IRON, MANGANESE, NICKEL, VANADIUM, AND ZINC WERE FOUND IN A SURFACE SAMPLE OF TEST PIT 6 (SAMPLE SS012). WITHIN THIS PIT, DARK REDDISH BROWN WATER WAS NOTED TO BE SEEPING FROM THE UPPER DEPTHS, SUGGESTING THAT THE HIGH CONCENTRATIONS WERE ATTRIBUTABLE TO THE WATER SEEPAGE. THIS SEEPAGE, HOWEVER, IS NOT BELIEVED TO HAVE ORIGINATED FROM THE TYSON'S SITE AS NONE OF THE ORGANIC COMPOUNDS ASSOCIATED WITH THE FORMER LAGOONS WERE FOUND IN SAMPLE SS012.

4. OPERABLE UNIT 4 - RAILROAD AREA

SOIL BORINGS WERE INSTALLED ON BOTH SIDES OF THE RAILROAD TRACKS. SOILS DEVELOPING ON BOTH SIDES OF THE RAILROAD ARE OF THE ROWLAND SERIES. THESE SOILS ARE DERIVED FROM THE WEATHERING OF MATERIALS WASHED FROM UPLANDS UNDERLAIN BY SHALES AND SANDSTONE AND ALLUVIAL DEPOSITS FROM PERIODIC FLOODING OF THE SCHUYLKILL RIVER. THESE DEPOSITS INCLUDE A LAYER OF COAL SEDIMENT WASHED FROM THE ANTHRACITE COAL REGIONS OF PENNSYLVANIA TO THE FAR NORTH OF THE SITE. UPSTREAM COAL PILES HAVE REPORTEDLY CONTRIBUTED TO COAL DEPOSITION IN THE RIVER DURING FLOOD EVENTS.

THE SURFACE OF EACH OF THE BORING LOCATIONS WAS COMPRISED PRIMARILY OF CINDER FILL USED IN THE CONSTRUCTION OF THE RAILROAD BED. A FIELD DESCRIPTION OF THE FILL MATERIAL REVEALED THAT IT CONSISTED PRIMARILY OF BOTTOM ASH FROM THE COAL COMBUSTION PROCESS. RELATIVE TO SOILS TYPICAL OF THE EASTERN UNITED STATES, THE CONCENTRATIONS OF THE INORGANIC CONSTITUENTS OF CADMIUM, CHROMIUM, MERCURY, AND SELENIUM ARE GREATER IN BOTTOM ASH THAN IN SOIL MATERIAL. SUBSEQUENTLY, IN AREAS WHERE BOTTOM ASH IS USED AS FILL MATERIAL, SOIL CONTAMINATION FROM THESE AND OTHER CONSTITUENTS MAY RESULT.

ORGANIC COMPOUNDS

ANALYTICAL ORGANIC ANALYSES FOR THE TEN BOREHOLES IS PRESENTED IN TABLE 4-20. NO ORGANIC COMPOUNDS WERE QUANTITATIVELY CONFIRMED IN SOIL SAMPLES COLLECTED FROM BORINGS 1, 8, 9, AND 10. ESTIMATED CONCENTRATIONS OF PYRENE (.22 MG/KG) WERE DETECTED IN BORING 1, 1 AND 1,2,3-TRICHLOROPORPANE (.151 MG/KG), TETRACHLOROETHENE

(.0073 MG/KG), AND TOTAL XYLENE (.0055 MG/KG) WERE DETECTED IN BORING 9.

INORGANIC CONSTITUENTS

THE CONCENTRATIONS OF INORGANIC CONSTITUENTS IN THE SUBSURFACE SOIL SAMPLES IS ALSO PRESENTED IN TABLE 4-20. ALL CONCENTRATIONS ARE WELL WITHIN OR BELOW THE TYPICAL RANGES REPORTED FOR SOILS IN THE EASTERN UNITED STATES. SOIL PH VALUES WERE GENERALLY NEUTRAL (I.E., 6.6 TO 7.3) EXCEPT FOR THE SAMPLES COLLECTED FROM BORING 5. VALUES FOR SOIL SAMPLES COLLECTED BETWEEN 4 AND 14 FEET RANGED FROM MODERATELY ALKALINE TO STRONGLY ALKALINE (7.9 TO 9.1). AN EXPLANATION FOR THESE ELEVATED PH VALUES IS NOT APPARENT.

5. OPERABLE UNIT 5 - FLOODPLAIN/WETLANDS

BASED ON TOPOGRAPHIC DIFFERENCES, THE FLOODPLAIN/WETLANDS OPERABLE UNIT SUPPORTS A DIVERSE FLORA CONSISTING OF BOTH UPLAND AND WETLAND-RELATED VEGETATION. THE FLOODPLAIN PROPER SUPPORTS PRIMARILY WETLAND RELATED FLORA. THE ELEVATED PORTION OF THE UNIT ADJACENT TO THE RAILROAD ACCESS ROAD SUPPORTS A MIX OF VEGETATION CONSISTING OF UPLAND AND WETLAND PLANTS. NO AREAS OF STRESSED VEGETATION WERE OBSERVED EITHER DURING FIELD INVESTIGATIONS OR FOLLOW-UP WALK-OVERS. EXAMINATION OF INFRARED PHOTOGRAPHS OF THE SITE AND SURROUNDING AREA SUPPORT THE FIELD OBSERVATIONS OF NO AREAS OF STRESSED VEGETATION.

THE SITE APPEARS TO SUPPORT A DIVERSE AND UNIMPACTED FLORA AND ASSOCIATED FAUNA. NO AREAS OF STRESSED VEGETATION WERE OBSERVED DURING THE SITE INVESTIGATIONS OR FROM PHOTO INTERPRETATION THE 1974 AND 1981 INFRARED AERIAL PHOTOGRAPHS. OBSERVATION OF FAUNA INDICATED RANDOM DISTRIBUTION WITH NO SPECIFIC AREA(S) OF AVOIDANCE.

THE SOILS IN THE FLOODPLAIN ARE CLASSIFIED BY THE SOIL CONSERVATION SURVEY AS ROWLAND SILT LOAM, COAL OVERWASH WITH A BOWMANVILLE HYDRIC COMPONENT. THE FORESTED COMPONENT CONSISTED OF RED MAPLE, GREEN ASH, BLACK WILLOW, RIVER BIRCH, AND PANICLED DOGWOOD. THE SCRUB-SHRUB COMPONENT INCLUDED YOUNG RED MAPLE, GREEN ASH, BITTERNUT HICKORY; SPICEBUSH, POISON IVY, AND BOXELDER. A NUMBER OF OTHER WETLAND RELATED UNDERSTORY PLANTS WERE LOCATED IN THIS AREA, INCLUDING SPOTTED JEWELWEED, JACK-IN-THE-PULPIT, AND PURPLE LOOSESTRIPE. WETLAND RELATED VEGETATION WAS OBSERVED THROUGHOUT THE FLOODPLAIN, ESPECIALLY IN THE VICINITY OF THE DRAINAGE DITCHES AND OTHER SCATTERED AREAS.

ORGANIC COMPOUNDS

THE ICE-HOUSE SAMPLE, WHICH WAS COLLECTED APPROXIMATELY 2000 FEET WEST OF THE FLOODPLAIN/WETLANDS OPERABLE UNIT, CONTAINED A NUMBER OF PAH COMPOUNDS (EXCLUDING THE ESTIMATED VALUES) INCLUDING: BENZO(A)ANTHRACENE, BENZO(1)PYRENE, BENZO(B)FLUORANTHENE, BENZO(K)FLUORANTHENE, CHRYSENE, FLUORANTHENE, PHENANTHRENE, AND PYRENE. EXCLUDING THE ESTIMATED PAH CONCENTRATIONS, PAHS WERE NOT FOUND IN THE AIR STRIPPER OUTFALL SAMPLES. PYRENE AND INDENO (1,2,3-CD)PYRENE WERE REPORTED IN ONE OF THE TWO SAMPLES TAKEN FROM THE WESTERN SWAMP AREA.

THE SOURCE OF THE PAD'S IN THE ICE-HOUSE SAMPLE (TOTAL PAH CONCENTRATION OF 9.26 MG/KG) MAY BE THE COAL SEDIMENT WASHED FROM THE ANTHRACITE REGION WELL TO THE NORTH OF THE SITE. THE SOIL CONSERVATION SURVEY (SCS) SOIL SURVEY FOR MONTGOMERY COUNTY STATES THAT THE ROWLAND SILT LOAM, WHICH OCCURS IN THE FLOODPLAIN OF THE SCHUYLKILL RIVER, DOES CONTAIN ANTHRACITE COAL SEDIMENT.

FIVE VOLATILE ORGANIC COMPOUNDS WERE DETECTED IN THE AIR STRIPPER OUTFALL SAMPLES. 1,2,3-TRICHLOROPROPANE WAS FOUND IN BOTH AIR STRIPPER SAMPLES (0.022 MG/KG AND 6.3 MG/KG). TRICHLOROETHYLENE (0.04 MG/KG) AND TETRACHLOROETHYLENE (.05 MG/KG) WERE FOUND IN THE INITIAL AIR STRIPPER SAMPLE ALONG WITH TOTAL XYLENE (0.4 MG/KG) AND CHLORBENZENE (0.09 MG/KG)

PESTICIDES WERE FOUND ONLY IN SOIL SAMPLES COLLECTED IN THE WESTERN SWAMP AREA. 4,4-DDD CONCENTRATIONS WERE 8.59 MG/KG AND 12.9 MG/KG; AND, DDE CONCENTRATIONS WERE 1.34 MG/KG AND 3 MG/KG.

INORGANIC CONSTITUENTS

CONCENTRATIONS OF INORGANIC CONSTITUENTS IN SOIL SAMPLES TAKEN FROM THE WEST SWAMP (SS067, SS069), AIR STRIPPER OUTFALL (SS068, SS070), AND ICE-HOUSE (SS066), ARE PRESENTED IN TABLE 4-30. WITH THE EXCEPTION OF ZINC, COPPER, SELENIUM, AND LEAD, INORGANIC CONSTITUENT CONCENTRATIONS WERE WELL WITHIN OR BELOW THE COMMONLY REPORTED RANGE FOR SOILS OF THE EASTERN UNITED STATES. ZINC AND LEAD LEVELS IN THE INITIAL SAMPLE (SS068) FROM THE AIR STRIPPER OUTFALL WERE SUBSTANTIALLY HIGHER THAN AVERAGE LEVELS. THIS IS MOST LIKELY ATTRIBUTABLE TO ANTHROPOGENIC SOURCES OF ZINC AND LEAD, HOWEVER, THESE SOURCES MAY NOT BE RELATED TO ACTIVITIES AT THE TYSON'S SITE AS HIGH LEVELS OF ZINC, 201200 MG/KG, AND LEAD, 218-10,900 MG/KG, ARE COMMONLY REPORTED FOR SIMILAR AREAS OF URBAN DEVELOPMENT. COPPER CONCENTRATIONS EXCEEDED TYPICAL LEVELS REPORTED FOR

SOILS OF THE EASTERN UNITED STATES IN THE INITIAL SAMPLE (SSO67) OBTAINED FROM THE WESTERN SWAMP LOCATION; SELENIUM EXCEEDED TYPICAL LEVELS IN THE SEPTEMBER SAMPLING AT THE WESTERN SWAMP. ELEVATED LEVELS OF THESE CONSTITUENTS, HOWEVER, HAVE BEEN REPORTED FOR SIMILAR ORGANIC RICH SOILS.

SIGNIFICANT VARIATIONS IN THE CONCENTRATION OF A NUMBER OF THESE INORGANIC CONSTITUENTS INCLUDING ALUMINUM, ZINC, LEAD, BARIUM, CHROMIUM, COPPER, IRON, MANGANESE, NICKEL AND VANADIUM WERE FOUND TO EXIST AMONG SAMPLING LOCATIONS AND BETWEEN SAMPLING DATES. THESE VARIATIONS ARE THOUGHT TO BE THE RESULT OF THE HETEROGENEITY OF THE SOILS DEVELOPING ON THE SCHUYLKILL RIVER FLOODPLAIN.

WITH REGARD TO THE SEDIMENT LAYER, THIS LAYER IS DERIVED PRIMARILY FROM COAL SEDIMENTS WASHED FROM THE ANTHRACITE REGIONS OF PENNSYLVANIA, NORTH OF THE SAMPLING AREA. THIS LAYER IS REPORTED TO VARY IN THICKNESS FROM 1 TO 3 FEET, SUBSEQUENTLY, VARIATIONS IN THE AMOUNT OF SEDIMENT PRESENT MAY SIGNIFICANTLY AFFECT THE CONCENTRATIONS OF INORGANIC CONSTITUENTS. FOR EXAMPLE, COAL SEDIMENTS ARE TYPICALLY HIGH IN IRON, SOIL SAMPLES TAKEN FROM AREAS WITH A THICKER SEDIMENT CAP WOULD BE EXPECTED TO EXHIBIT HIGHER IRON CONCENTRATIONS THAN THOSE OBTAINED FROM AREAS WITH A THINNER SEDIMENT CAP.

6. COMPARISON OF ORGANIC COMPOUNDS DETECTED IN ON-SITE AND OFF-SITE SAMPLES

TABLE 4-36 IS A COMPARISON OF THE ORGANIC COMPOUNDS DETECTED IN THE FORMER LAGOON AREA DURING THE ABOVE INVESTIGATIONS AND THE ORGANIC COMPOUNDS DETECTED IN THE OFF-SITE OPERABLE UNITS DURING THE ON-SITE RI AND THE OFF-SITE OPERABLE UNIT RI. A BROAD SUITE OF SIMILAR ORGANIC COMPOUNDS WERE DETECTED IN BOTH THE FORMER LAGOON AREAS AND THE VARIOUS OFF-SITE OPERABLE UNITS. POSSIBLE SOURCES OF THE PAHS TO THE OFF-SITE OPERABLE UNITS INCLUDE THE FOLLOWING:

- * COAL FINES WASHED DOWNRIVER FROM COAL CRUSHING/WASHING AND STORAGE OPERATIONS ALONG THE NORTHERN REACHES OF THE RIVER;
- * BURNING OF CONSTRUCTION MATERIALS;
- * BOTTOM ASH USED AS FILL MATERIAL FOR THE RAILROAD BALLAST;
- * MATERIALS USED FOR MAINTENANCE AND CONSTRUCTION OF THE RAILROAD;
- * SPILLS OF COAL, COAL RELATED PRODUCTS, AND CHEMICALS DURING THE TRANSPORT OF THESE MATERIALS VIA THE RAILROAD;
- * FLY ASH AND GASEOUS EMISSIONS FROM THE COAL FIRED GENERATING STATION ON BARBADOS ISLAND;

#SSR

C. SUMMARY OF SITE RISKS

THE FOLLOWING CONCLUSIONS ARE BASED ON THE ANALYSES PERFORMED IN THE OFF-SITE OPERABLE UNIT RI/FS.

- * THE MAXIMUM DETECTED LEVELS OF NUMEROUS VOLATILE AND SEMI-VOLATILE COMPOUNDS DETECTED IN THE BEDROCK AQUIFER EXCEEDS ACCEPTABLE LEVELS.
- * THE POTENTIAL NONCARCINOGENIC RISKS POSED BY OPERABLE UNITS 2 THROUGH 5 ARE ACCEPTABLE.
- * THE DISCHARGE OF CONTAMINANTS TO THE SCHUYLKILL RIVER VIA THE BEDROCK AQUIFER EXCEEDS ACCEPTABLE LEVELS.
- * THE POTENTIAL CARCINOGENIC RISK POSED BY OPERABLE UNITS 2 THROUGH 5 ARE ACCEPTABLE.

IN SUMMARY, AMBIENT SITE CONDITIONS FOR OPERABLE UNITS 2 THROUGH 5 REPRESENT ANY ACCEPTABLE LEVEL OF RISK. HOWEVER, A REDUCTION OF THE TOXICITY, MOBILITY AND VOLUME OF THE CONTAMINATED BEDROCK AQUIFER REPRESENTS A DESIRABLE ACTION FOR PROTECTION OF HUMAN HEALTH AND THIS ENVIRONMENT.

#CRH

V. COMMUNITY RELATIONS HISTORY

RESIDENTS LIVING NEAR THE TYSONS' SUPERFUND SITE HAVE ALWAYS BEEN HIGHLY INTERESTED IN THE FORMER LAGOON AREA OF THE SITE WHICH IS PRESENTLY UNDERGOING REMEDIAL ACTION. HOWEVER, EPA HAS NEVER RECEIVED QUESTIONS ABOUT THE OPERABLE UNITS, OR OFF SITE AREAS. UPPER MERION TOWNSHIP OFFICIALS ARE INVOLVED WITH EVERY ASPECT OF THE SITE, BUT THE LOCAL RESIDENTS ARE MORE CONCERNED WITH PROGRESS IN THE MAIN AREA.

EPA PLACED AN ADVERTISEMENT LISTING CLEANUP ALTERNATIVES FOR THE OPERABLE UNITS IN THE NORRISTOWN TIMES HERALD ON SEPTEMBER 4, 1988. THE AD ALSO ANNOUNCED THE PUBLIC COMMENT PERIOD WHICH RAN FROM SEPTEMBER 4 THROUGH SEPTEMBER 26, 1988. NO WRITTEN ORAL COMMENTS WERE RECEIVED BY EPA DURING THAT TIME.

#RAO

VI. REMEDIAL ALTERNATIVE OBJECTIVES

THE MAJOR OBJECTIVE OF REMEDIAL ACTIONS TO BE TAKEN AT THE OFF-SITE OPERABLE UNITS OF THE TYSON'S SITE IS TO RECOVER AND TREAT GROUNDWATER DISCHARGING TO THE SCHUYLKILL RIVER TO LEVELS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

BASED ON THE ABOVE OBJECTIVE, NUMEROUS GROUNDWATER TREATMENT TECHNOLOGIES WERE SCREENED TO PROVIDE A LIMITED NUMBER OF TECHNOLOGIES APPLICABLE FOR REMEDIAL ACTION AT THE SITE. SOME OF THESE TECHNOLOGIES WERE REMOVED FROM FURTHER CONSIDERATION BASED ON SITE SPECIFIC INFORMATION AND OTHER COMPARATIVE CRITERIA LISTED BELOW;

EFFECTIVENESS

- * PERFORMANCE REDUCTION IN MOBILITY, TOXICITY, OR VOLUME
- * PERMANENCE
- * LONG TERM MANAGEMENT

RELIABILITY

- * OPERATION AND MAINTENANCE (O&M) REQUIREMENTS
- * FAILURE POTENTIAL

#DA

II. DESCRIPTION OF THE ALTERNATIVES

A. REMEDIAL ALTERNATIVE EVALUATION - OPERABLE UNIT 1 - BEDROCK AQUIFER

1. NO ACTION - THIS ALTERNATIVE WILL HAVE NO ENVIRONMENTAL OR PUBLIC HEALTH BENEFITS. IT WILL NOT BE PROTECTIVE IN THE SHORT-TERM OR LONG-TERM. THIS ALTERNATIVE WOULD NOT ACHIEVE THE ARARS. THERE WILL BE NO REDUCTION OF TOXICITY, MOBILITY OR VOLUME SINCE TO RECOVERY OR TREATMENT IS INVOLVED. BASED ON THE ABOVE, THIS ALTERNATIVE WILL NOT BE CONSIDERED FURTHER.

2. PUMP AND TREATMENT - THIS INVOLVES THE RECOVERY AND TREATMENT OF CONTAMINATED GROUNDWATER DISCHARGING INTO THE SCHUYLKILL RIVER. THE TREATMENT OF GROUNDWATER REDUCES OFF-SITE RISK TO RIVER. TOXICITY AND VOLUME OF CONTAMINANTS IN GROUNDWATER REDUCED BY TREATMENT. ALL CONTAMINATED SPECIFIC ARARS WILL BE MET.

A. TECHNOLOGIES AVAILABLE

THE TECHNOLOGIES THAT HAVE BEN RETAINED FOR ASSEMBLY INTO REMEDIAL ALTERNATIVES ARE DESCRIBED BELOW:

1. AIR STRIPPING

AIR STRIPPING, TO REMOVE ORGANICS FROM WATER, IS PER-FORMED BY PASSING AIR THROUGH THE WATER TO FACILITATE TRANSFER OF VOLATILE ORGANICS FROM THE LIQUID PHASE TO THE GAS (AIR) PHASE. THESE VOLATILES ARE THEN REMOVED IN THE STRIPPER OFFGAS. THE DEGREE TO WHICH STRIPPING IS SUCCESSFUL AT REMOVING VOLATILES FROM A LIQUID STREAM DEPENDS ON THE VOLATILITY OF THE COMPOUNDS PRESENT, THE VOLUMETRIC RATIO OF AIR TO WATER FLOW, THE SURFACE AREA OF THE AIR/LIQUID INTERFACE, AND THE TEMPERATURE AT WHICH STRIPPING IS CONDUCTED.

THREE METHODS OF AIR STRIPPING ARE MOST PREVALENT: DIFFUSED AERATION, MECHANICAL AERATION, AND PACKED OR SPRAY TOWER STRIPPING. COUNTERCURRENT PACKED TOWER AIR STRIPPING HAS BEEN MOST FREQUENTLY EMPLOYED FOR GROUNDWATER CLEANUP OPERATIONS AND IS GENERALLY THE MOST EFFICIENT STRIPPING PROCESS FOR REMOVAL OF VOLATILE COMPOUNDS. VOC AIR EMISSION FROM THE STRIPPER OFF-GAS MAY REQUIRE FURTHER TREATMENT TO MAINTAIN ACCEPTABLE AMBIENT AIR QUALITY STANDARDS.

2. STEAM STRIPPINGS

STEAM STRIPPING REQUIRES THE DISSOLVED ORGANIC COMPOUNDS TO BE TRANSFERRED FROM THE INFLUENT WATER TO STEAM. THE STEAM IS THEN CONDENSED AND THE ORGANIC COMPOUNDS ARE STORED AT THE PLANT AND THEN SHIPPED OUT FOR RECYCLING OR INCINERATION. THE WATER CONDENSATE IS THEN SENT BACK TO THE STEAM STRIPPER AND MIXED WITH THE INFLUENT WATER. THE CONDENSER IS VENTED AND THE VAPOR IS TREATED BY PASSING THROUGH VAPOR-PHASE CARBON ADSORPTION UNITS. THE VOLUME OF VAPOR RELEASED FROM THE CONDENSER AND PASSED THROUGH CARBON IS VERY SMALL COMPARED TO THE VOLUME OF AIR PASSED THROUGH CARBON FROM A CONVENTIONAL AIR STRIPPER. THUS, THE VAPOR-PHASE ADSORPTION UNITS ARE RELATIVELY SMALL. THE CARBON IS REGENERATED ON-SITE PERIODICALLY USING STEAM AND THE CONDENSATE FROM THE REGENERATION PROCESS IS HANDLED IN THE SAME WAY THAT THE CONDENSATE FROM THE CONDENSER IS HANDLED. STEAM STRIPPING IS EXTREMELY EFFICIENT IN THE REMOVAL OF VOLATILE AND SEMI-VOLATILE ORGANIC COMPOUNDS. IF UNSTRIPPABLE ORGANIC COMPOUNDS ARE ENCOUNTERED, THEY ARE REMOVED BY ADDING LIQUID-PHASE CARBON ADSORPTION TO THE SYSTEM.

3. THERMAL OXIDATION (OFF-GAS CONTROL)

THERMAL OXIDATION CAN BE USED TO TREAT THE GAS-PHASE DISCHARGE FROM AN AIR STRIPPER. THERMAL OXIDATION USES HIGH TEMPERATURE UNDER CONTROLLED CONDITIONS TO DEGRADE A CONSTITUENT INTO PRODUCTS THAT MAY INCLUDE CARBON DIOXIDE, WATER VAPOR, HYDROCHLORIC ACID, SULFUR DIOXIDE, AND NITROUS OXIDE GASES.

ORGANIC MATERIALS CAN ORDINARILY BE BURNED IF THEY ARE MIXED WITH AIR TO PROVIDE OXYGEN CONTENT IN THE 10 PERCENT TO 15 PERCENT RANGE, HAVE A HYDROCARBON CONCENTRATION ABOVE A LOWER EXPLOSIVE LIMIT (LEL), AND ARE HEATED ABOVE AN AUTO-IGNITION TEMPERATURE. THE RESULTING COMBUSTION CAN PRODUCE ESSENTIALLY COMPLETE OXIDATION OF THE COMBUSTION MIXTURE. THE LOWER EXPLOSIVE LIMIT IS THE CONCENTRATION OF ANY ORGANIC MATERIAL THAT PRODUCES TEMPERATURES HIGH ENOUGH TO SUSTAIN FLAME REACTIONS. THESE REACTIONS RESULT IN THE FORMATION OF THE REACTIVE FREE RADICAL SULFUR DIOXIDE AND NITROUS OXIDES. TREATMENT OF THE AIR STRIPPER OFF-GAS MAY BE DONE THERMALLY WITH OR WITHOUT CATALYTIC ASSISTANCE.

4. VAPOR-PHASE CARBON ADSORPTION

VAPOR-PHASE CARBON (VPC) TREATMENT CAN ALSO BE EMPLOYED FOR TREATING THE GAS-PHASE DISCHARGE FROM AN AIR STRIPPER. VPC SYSTEMS CONSIST OF COLUMNS OF ADSORBENT (ACTIVATED CARBON) WITH A TYPICAL DENSITY OF 30 LB/FT³. THE VAPOR-PHASE CARBON PARTICLES ARE LARGER THAN CORRESPONDING LIQUID PHASE CARBON PARTICLES AND HAVE LARGE AND HIGHLY PERMEABLE VOID SPACES. CONTAMINATED AIR FLOWS THROUGH THE COLUMNS OR CARBON BED, AND ORGANICS ADSORB ONTO THE CARBON. THE TREATED AIR THEN LEAVES THE BED WITH REDUCED CONCENTRATIONS OF CONTAMINANTS UNTIL THE CARBON ADSORBENT HAS REACHED CAPACITY AND IS REPLACED OR REGENERATED.

5. GRANULAR ACTIVATED CARBON (LIQUID-PHASE ADSORPTION)

CARBON ADSORPTION INVOLVES CONTACTING A WASTE STREAM WITH CARBON, USUALLY BY FLOW, THROUGH A SERIES OF PACKED BED REACTORS. MOLECULAR ADSORPTION BY WAY OF CHEMICAL FORCES ADHERE VOLATILE MOLECULES ON THE SURFACES OF THE CARBON PARTICLE. ACTIVATED CARBON'S FAVORABLE ADSORPTIVE PROPERTIES ARE RELATED TO ITS HIGH AVAILABLE SURFACE AREA. CONTAMINANTS ARE REMOVED FROM THE WASTE STREAM AND ADSORBED FROM THE LIQUID PHASE ONTO AND INTO THE SOLID CARBON PHASE PORE STRUCTURE. LARGER, MORE HIGHLY BRANCHED, LESS SOLUBLE COMPOUNDS ARE MOST READILY ADSORBED. THE DEGREE TO WHICH CARBON ADSORPTION CAN BE USED TO REMOVE CONTAMINANTS FROM A WASTE STREAM IS DEPENDENT ON THE SPECIFIC COMPOUNDS TO BE REMOVED, CONCENTRATIONS OF OTHER ORGANICS IN THE STREAM, AND THE CHOICE OF CARBON MATERIAL.

ONCE THE MICROPORE SURFACES OF THE GAC ARE SATURATED WITH ORGANICS, THE CARBON IS "SPENT" AND MUST EITHER BE REPLACED WITH VIRGIN CARBON OR REMOVED, REGENERATED, AND REPLACED. CARBON "BREAKTHROUGH" REFERS TO THE CONDITION IN WHICH A SPECIFIED EFFLUENT CONCENTRATION LIMIT IS EXCEEDED. COMPLETE EXHAUSTION OF A BED OCCURS WHEN THE CARBON IS COMPLETELY SPENT (NO FURTHER ADSORPTION OF THE CONTAMINANTS(S) CAN OCCUR). THE OPERATING TIME AVAILABLE BEFORE REACHING BREAKTHROUGH IS THE SINGLE MOST CRITICAL OPERATING PARAMETER IN CARBON SYSTEM DESIGN, HOWEVER, BACKUP CARBON UNITS ARE EMPLOYED IN THE RARE CASE OF FAILURE.

6. CHEMICAL OXIDATION

THE CHEMICAL OXIDATION PROCESS CONSISTS OF ADDING AN OXIDIZING AGENT, SUCH AS HYDROGEN PEROXIDE, FENTON'S REAGENT, OZONE, OR HYPOCHLORITE (SOMETIMES IN CONJUNCTION WITH CATALYSTS OR ULTRAVIOLET RADIATION) TO A WASTE STREAM TO CONVERT ORGANICS TO MORE HIGHLY OXIDIZED INTERMEDIATES OR ULTIMATELY TO CARBON DIOXIDE AND WATER, DEPENDING ON THE OXIDANT USED. PARTIALLY OXIDIZED INTERMEDIATES MAY BE MORE OR LESS READILY TREATABLE OR TOXIC THAN PARENT COMPOUNDS, DEPENDING ON THE REACTION PATHWAYS FOLLOWED.

CHEMICAL OXIDATION PROCESSES ARE USUALLY CARRIED OUT IN A CONTINUOUS FLOW MODE. WATER TO BE TREATED ENTERS TANK WHERE THE WATER IS MIXED WITH THE OXIDIZING AGENT, WITH OR WITHOUT ULTRAVIOLET (UV) IRRADIATION. TANK HYDRAULIC DETENTION TIME VARIES, BASED ON RESULTS OBTAINED EMPIRICALLY IN TREATABILITY STUDIES.

B. ALTERNATIVE PRESENTATION

WHILE NOT ONE OF THE ABOVE TECHNOLOGIES CAN REMEDIATE THE FULL RANGE OF CONTAMINANTS AT THE SITE, COMBINATIONS OF THESE TECHNOLOGIES MAY. FROM THE TECHNOLOGIES DISCUSSED ABOVE TWELVE REMEDIAL ALTERNATIVE FOR GROUNDWATER TREATMENT HAVE BEEN DEVELOPED.

1. SUMMARY OF ALTERNATIVES

TABLES, 3-5, 3-6, 3-7, AND 3-8 SUMMARIZE THE ALTERNATIVES ACCORDING TO THE APPLICABLE ASSESSMENT FACTORS. THE FOLLOWING IS A SUMMARY OF THE REMEDIAL MEASURES.

ALTERNATIVE 1 - GROUNDWATER TREATMENT BY AIR STRIPPING

ALTERNATIVE 2 - GROUNDWATER TREATMENT BY AIR STRIPPING, WITH
THERMAL OXIDATION FOR GASEOUS EMISSIONS TREATMENT

ALTERNATIVE 3 - GROUNDWATER TREATMENT BY AIR STRIPPING, WITH
VAPOR PHASE CARBON (VPC) FOR THE GASEOUS
EMISSIONS TREATMENT

ALTERNATIVE 4 - GROUNDWATER TREATMENT BY AQUEOUS-PHASE
GRANULAR ACTIVATED CARBON (GAC)

ALTERNATIVE 5 - GROUNDWATER TREATMENT BY AIR STRIPPING
FOLLOWED BY AQUEOUS-PHASE GAC POLISHING FOR
NON-STRIPPABLE COMPOUND REMOVAL

ALTERNATIVE 6 - GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH THERMAL OXIDATION, FOLLOWED
BY AQUEOUS-PHASE GAC POLISHING

ALTERNATIVE 7 - GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH VAPOR PHASE CARBON,
FOLLOWED BY AQUEOUS-PHASE GAC POLISHING

ALTERNATIVE 8 - GROUNDWATER TREATMENT BY AIR STRIPPING
FOLLOWED BY UV/PEROXIDATION POLISHING FOR
NONSTRIPPABLE COMPOUND REMOVAL

ALTERNATIVE 9 - GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH THERMAL OXIDATION FOLLOWED
BY UV/PEROXIDATION POLISHING

ALTERNATIVE 10 - GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH VAPORPHAS CARBON FOLLOWED
BY UV/PEROXIDATION POLISHING.

ALTERNATIVE 11 - STEAM STRIPPING AND VAPOR PHASE CARBON
ADSORPTION ON CONDENSER VENT STACK

ALTERNATIVE 12 - STEAM STRIPPING AND VAPOR PHASE CARBON
ADSORPTION ON CONDENSER VENT STACK AND
LIQUID-PHASE CARBON

ALTERNATIVE 1 AND 4 REPRESENT ALTERNATIVES COMPOSED OF A MEANS OF RECOVERING GROUNDWATER FOR TREATMENT AND A SINGLE TECHNOLOGY DESIGNED TO ACCOMPLISH THAT TREATMENT. ALTERNATIVES 2, 3 AND 11 ARE AN ENHANCEMENT OF ALTERNATIVE 1 TO PROVIDE AIR EMISSIONS CONTROLS SHOULD AIR OR STEAM STRIPPER EMISSIONS EXCEED ACCEPTABLE CRITERIA. ALTERNATIVES 5, 6, AND 7 AND 8, 9, 10 AND 12 BUILD ON ALTERNATIVES 1, 2, 3 AND 11 TO ACCOUNT FOR NON-STRIPPABLE COMPOUND REMOVAL SHOULD IT BE REQUIRED.

B. REMEDIAL ALTERNATIVES EVALUATION - OPERABLE UNITS 2 THROUGH 5

ALTERNATIVES FOR THE REMEDIATION OF OFF-SITE OPERABLE UNITS 2 THROUGH 5 WERE NOT PROVIDED IN THE OFF-SITE FS BASED ON THE JULY 1987 ENDANGERMENT ASSESSMENT FINDINGS OF ACCEPTABLE RISK AND ALSO ON PRACTICAL CONSIDERATIONS. THE FOLLOWING IS SUMMARY OF SIGNIFICANT CONCLUSIONS OF THE REMEDIAL INVESTIGATION AND ENDANGERMENT ASSESSMENT CONDUCTED FOR THESE OPERABLE UNITS.

HILLSIDE AREA (OPERABLE UNIT 2)

- * COMPOUNDS DETECTED IN THE FORMER LAGOONS WERE DETECTED AT TRACE LEVELS IN SEVERAL OF THE SAMPLES COLLECTED IN THIS AREA. THIS INDICATES THAT OVERLAND FLOW AND/OR SHALLOW GROUNDWATER DISCHARGE FROM THE FRACTURED BEDROCK OUTCROP IN THIS AREA PROBABLY OCCURRED DURING OPERATION OF THE LAGOONS;
- * THE TOTAL VOLUME OF CONTAMINATED SOIL IN THE HILLSIDE AREA IS MINIMAL, WITH DEPTH TO BEDROCK USUALLY BEING ONE OR TWO FEET AND WITH EXPOSED BEDROCK PRESENT IN MUCH OF THE AREA.
- * EXPOSURE TO CONTAMINATED HILLSIDE SOILS IS POSSIBLE VIA DERMAL CONTACT WITH THE SOILS AND INCIDENTAL INGESTION OF SUCH SOILS.
- * THE CARCINOGENIC RISK TO CHILDREN OF EXPOSURE TO CONTAMINATED HILLSIDE SOILS IS NEGLIGIBLE (LESS THAN 10^{-6}). ACCORDINGLY, NO SIGNIFICANT SUBCHRONIC OR NONCARCINOGENIC HAZARD IS PRESENT.

RAILROAD AREA (OPERABLE UNIT 3)

- * A WIDE VARIETY OF ORGANIC AND INORGANIC COMPOUNDS WAS FOUND THROUGHOUT THIS AREA, BOTH ASSOCIATED WITH THE FORMER LAGOON AREA, AND WITH THE MATERIALS USED FOR THE RAILROAD BALLAST,
- * EXPOSURE OF RAILROAD WORKERS TO CONTAMINATED SOILS VIA DERMAL CONTACT IS POSSIBLE IN THE RAILROAD AREA
- * THE CARCINOGENIC RISK TO RAILROAD WORKERS OF EXPOSURE TO CONTAMINATED RAILROAD AREA SOILS IS LESS THAN 10^{-6} AND IS, THEREFORE, IN CONFORMANCE WITH EPA GUIDELINES. ACCORDINGLY NO SIGNIFICANT SUBCHRONIC OR NONCARCINOGENIC HAZARD IS PRESENT.

FLOODPLAIN/WETLANDS AREA (OPERABLE UNIT 4)

- * TRACE LEVEL OF SITE-RELATED CONTAMINANTS WERE DETECTED IN THE DITCHES AND DRAINAGEWAYS RECEIVING RUNOFF FROM THE SITE AND DISCHARGE FROM THE EPA-INSTALLED AIR STRIPPER.
- * NO ACUTE OR CHRONIC EFFECTS WERE OBSERVED IN THE FISH SPECIES STUDIED; THE RESULTS OF THE TESTING WITH DAPHNIA WERE INCONCLUSIVE.
- * RESULTS OF THE LIQUID PHASE ELUTRIATE CHEMICAL ANALYSIS AND BIOASSAY SHOW NO POTENTIAL ACUTE TOXICITY WITH DAPHNIA IN THE SEDIMENTS STUDIED.
- * NO ADVERSE EFFECTS ON ANY ORGANISMS INVESTIGATED DURING THE BIOLOGICAL STUDIES COULD BE ATTRIBUTED TO SITE-RELATED CONSTITUENTS.
- * EXPOSURE TO CONTAMINATED SEDIMENTS AND SURFACE WATER IN

THE FLOODPLAIN AREA VIA DERMAL CONTACT AND INCIDENTAL INGESTION OF SOILS IS POSSIBLE. INHALATION OF CONTAMINANTS VOLATILIZED FROM SOILS AND SURFACE WATER IN THE FLOODPLAIN AREA IS A NEGLIGIBLE SOURCE OF EXPOSURE.

- * THE ESTIMATED CARCINOGENIC RISK OF DERMAL CONTACT WITH INCIDENTAL INGESTION OF CONTAMINATED SOILS AND SURFACE WATER IS LESS THAN 10^{-6} , CONFORMING TO EPA GUIDELINES. ACCORDINGLY, NO SIGNIFICANT SUBCHRONIC OR NONCARCINOGENIC HAZARD IS PRESENT. THE ESTIMATED INTAKE DUE TO INHALATION OF CONTAMINANTS VOLATILIZED FROM SURFACE WATER AND SOILS IN THE FLOODPLAIN AREA IS LESS THAN ONE PERCENT OF THE TOTAL INTAKE OF INDICATOR COMPOUNDS. CONSEQUENTLY, THIS PATHWAY OF EXPOSURE DOES NOT PRESENT A HAZARD AND WAS NOT CONSIDERED FURTHER.

SEEP AREA (OPERABLE UNIT 5)

- * ELEVEN OF THE SIXTEEN SAMPLES TAKEN FROM THIS AREA HAD NO DETECTABLE HAZARDOUS SUBSTANCE LIST (HSL) ORGANIC COMPOUNDS. THE HIGHEST SINGLE CONCENTRATION OF HSL ORGANICS DETECTED CONSISTED OF NON-SITE-RELATED PAHS.
- * THE ORIGIN OF THE SEEP REMAINS UNKNOWN BUT IS PROBABLY RELATED TO SHALLOW GROUNDWATER FLOW IN THIS AREA; THE SEEP HAS NOT RECURRED SINCE INITIAL RESTORATION OF THE AREA.
- * THE CARCINOGENIC RISK OF EXPOSURE TO CONTAMINATED SEEP AREA SOILS IS ESTIMATED AT LESS THAN 10^{-6} . THIS RISK IS WITHIN EPA GUIDELINES. ACCORDINGLY, NO SIGNIFICANT SUBCHRONIC OR NONCARCINOGENIC HAZARD IS PRESENT.

II. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

THE IDENTIFICATION OF APPROPRIATE ARARS DEPENDS UPON THE RECOGNIZED USES AND DESIGNATIONS OF THE ENVIRONMENTAL RESOURCES AND MEDIA OF CONCERN. ARARS ARE DIVIDED INTO THREE MAIN CATEGORIES.

- * CONTAMINANT-SPECIFIC ARARS;
- * ACTION-SPECIFIC ARARS; AND
- * LOCATION-SPECIFIC ARARS.

CONTAMINANT-SPECIFIC ARARS

THE SOURCES OR MEDIA OF CONCERN FOR THE OFF-SITE FS INCLUDE AIR, GROUNDWATER, SURFACE WATER (SCHUYLKILL RIVER) AND WETLANDS/FLOODPLAINS. CONTAMINANT SPECIFIC ARARS FOR AIR, GROUNDWATER, SURFACE WATER AND WETLANDS/FLOODSPLAINS ARE PRESENTED IN TABLE 3-1. THE CLASSIFICATION AND USE OF EACH RESOURCE AND THE BASIS FOR THE ARARS ARE PRESENT AS FOLLOWS:

* AIR

MONTGOMERY COUNTY, PENNSYLVANIA, WHERE THE TYSON'S SITE IS LOCATED, IS IN A NON-ATTAINMENT AREA FOR OZONE AS PER THE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) PROMULGATED UNDER THE CLEAN AIR ACT. THE NAAQS ARE ENFORCEABLE STANDARDS APPLICABLE AT DESIGNATED AMBIENT AIR MONITORING LOCATIONS. 265 PA CODE SECTION 127.11 REQUIRES A PLAN APPROVAL FOR AIR STRIPPERS AND OTHER EQUIPMENT DESIGNED TO REMOVE VOLATILE CONTAMINANTS FROM SOIL, WATER, AND OTHER MATERIALS. AMBIENT AIR QUALITY GUIDELINES SET FORTH BY PADER UNDER THE INTERIM OPERATING GUIDELINES FOR

AIR TOXIC SUBSTANCES (ATGS) ARE POSSIBLE ARARS; EXEMPTIONS MAY BE GRANTED FROM THE PERMIT REQUIREMENTS IF:

(1) STACK CONCENTRATIONS OF EACH INDIVIDUAL AIR TOXIC CONSTITUENTS DO NOT EXCEED ONE-THIRD OF THE ATG AMBIENT GUIDELINE CONCENTRATIONS, AND (2) POTENTIAL (BEFORE CONTROL) EMISSION RATES OF ALL LISTED AIR TOXICS DO NOT EXCEED A TOTAL OF ONE POUND PER HOUR. FOR THOSE COMPOUNDS LACKING OTHER ARARS RISK-BASED CALCULATED STACK EMISSIONS CONCENTRATIONS (TABLE 3-2) ARE ALSO POSSIBLE ARARS. THESE ARE CALCULATED TO BE PROTECTIVE OF HUMAN HEALTH FOR BOTH CARCINOGENIC AND NONCARCINOGENIC EFFECTS BASED, FOR THE FLOODPLAIN AREA, ON A RESIDENTIAL RECEPTOR 300 METERS FROM THE STACK.

GROUNDWATER

- * GROUNDWATER CLEANUP STANDARDS FOR THE BEDROCK AQUIFER HAVE BEEN SET BY EPA AND DER. THESE LEVELS, BASED ON THE PARTIAL CONSENT DECREE, ARE GIVEN IN TABLE 3-3. GROUNDWATER BENEATH THE TYSON'S SITE BETWEEN THE FORMER LAGOON AREA AND THE RIVER IS NOT USED FOR DRINKING WATER, HOUSEHOLD, OR OTHER USE. THE EXPOSURE POINT OF CONCERN FOR THE GROUNDWATER CONSIDERED IN THIS STUDY IS THE SCHUYLKILL RIVER, TO WHICH THIS GROUNDWATER DISCHARGES. FOR THE PURPOSES OF THIS STUDY, CLEAN-UP STANDARDS FOR EXTRACTED, TREATED GROUNDWATER MAY BE DERIVED FROM THOSE ARARS APPLICABLE TO SURFACE WATER IN CONJUNCTION WITH PADER STATED DISCHARGE LIMITS FOR TREATED GROUNDWATER AT THE SITE. WHERE MORE THAN ONE ARAR WAS AVAILABLE FOR A GIVEN COMPOUND IN SURFACE WATER THE MOST STRINGENT OF THE ARARS WAS EMPLOYED. IN ADDITION, BECAUSE A NUMBER OF COMPOUNDS AT THE SITE DID NOT HAVE ARARS FOR PROTECTION OF HUMAN HEALTH, RISK-BASED CONCENTRATIONS ALLOWABLE IN SCHUYLKILL RIVER WATER FOR PROTECTION OF HUMAN HEALTH WERE DEVELOPED FOR THESE COMPOUNDS.

SAFE DRINKING WATER ACT MAXIMUM CONTAMINANT LEVELS (MCLS) ARE POSSIBLE ARARS APPLIED "AT THE TAP", OR AT THE POINT OF HUMAN CONSUMPTION. FEDERAL AMBIENT WATER QUALITY CRITERIA (WQC) FOR THE PROTECTION OF HUMAN HEALTH ARE AMBIENT CONCENTRATION GUIDELINES, AND ARE POTENTIAL ARARS. FEDERAL WQC FOR THE PROTECTION OF AQUATIC LIFE AND PENNSYLVANIA WATER QUALITY CRITERIA ARE ALSO POSSIBLE ARARS AND ARE APPLIED.

A SUMMARY OF PROJECTED ALLOWABLE EFFLUENT CONCENTRATION DERIVED FROM SURFACE WATER ARARS AND OTHER SOURCES IS GIVEN IN TABLE 3-2. THE RISK-BASED CONCENTRATIONS FOR BOTH AIR AND SURFACE WATER ARARS WERE CALCULATED USING AN ACCEPTABLE RISK LEVEL OF 1×10^{-6} FOR CARCINOGENS, AND "NO ADVERSE TOXIC EFFECT LEVELS" FOR NONCARCINOGENS.

THE EFFLUENT LIMITS LISTED IN TABLE 3-2 WILL ALSO SERVE AS INTERIM GROUNDWATER CLEAN-UP STANDARDS; I.E. INTERIM CLEAN-UP WILL BE COMPLETED WHEN THE CONCENTRATIONS OF THE LISTED COMPOUNDS IN UNTREATED GROUNDWATER ARE BELOW THE EFFLUENT CONCENTRATIONS SELECTED FOR TREATED GROUNDWATER. AT THAT TIME, THE EFFECTIVENESS OF THE GROUNDWATER TREATMENT SYSTEM WILL NEED TO BE RE-EVALUATED.

ACTION-SPECIFIC ARARS

AT PRESENT, THERE ARE NO TECHNOLOGY-BASED STANDARDS APPLICABLE TO THE TYPES OF REMEDIAL ACTIONS PROPOSED.

LOCATION-SPECIFIC ARARS

BECAUSE THE PROPOSED TREATMENT FACILITY FOR RECOVERED GROUNDWATER WOULD HAVE TO BE LOCATED IN THE SCHUYLKILL RIVER FLOOD-PLAIN/WETLANDS PORTION OF THE OFF-SITE AREA, LOCATION SPECIFIC ARARS ARE POTENTIALLY APPLICABLE IN THE EVENT THAT PHYSICAL CONSTRUCTION IN UNDISTURBED AREAS IS NECESSARY. EXECUTIVE ORDER 11988 MANDATES THAT FLOODPLAIN DEVELOPMENT NOT BE FAVORED WHEN OTHER FEASIBLE ALTERNATIVES ARE AVAILABLE. BECAUSE THE EXTRACTION WELLS ARE, OF NECESSITY, LOCATED IN THE 100-YEAR FLOODPLAIN FOR THE SCHUYLKILL RIVER, THE CLOSEST TO THE WELLS THAT THE TREATMENT FACILITY COULD BE OUTSIDE THE FLOODPLAIN WOULD BE IN THE CONRAIL SWITCHING YARD OR THE STEEP BANKS OF THE HILLSIDE AREA. THESE LOCATIONS DO NOT OFFER ADEQUATE SPACE FOR SUCH A FACILITY. CONSEQUENTLY, LOCATION OF THE GROUNDWATER TREATMENT SYSTEM OUTSIDE THE 100-YEAR FLOODPLAIN CANNOT BE PRACTICALLY ACCOMPLISHED.

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IX. COMPARATIVE ANALYSIS

A. OPERABLE UNIT 1 - BEDROCK AQUIFER ALTERNATIVES (SEE TABLE 3-5, 3-6, 3-7, AND 3-8.

ALTERNATIVE 1. GROUNDWATER TREATMENT BY AIR STRIPPING

AIR STRIPPING WITHOUT EMISSIONS CONTROL IS EXPECTED TO EXCEED THE ACCEPTABLE STANDARDS FOR AIR. INHERENT COMPOUND TOXICITY IS NOT REDUCED BUT SIMPLY TRANSFERRED FROM THE AQUEOUS TO THE VAPOR PHASE. THE VOLUME OF CONTAMINATED GROUNDWATER IS DECREASED. NON-STRIPPABLE COMPOUNDS WOULD NOT BE DESTROYED IN THIS TREATMENT PROCESS.

ALTERNATIVE 2. GROUNDWATER TREATMENT BY AIR STRIPPING, WITH THERMAL OXIDATION FOR GASEOUS EMISSIONS TREATMENT

ALTERNATIVE 2 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THE ALTERNATIVE DOES SIGNIFICANTLY REDUCE COMPOUND TOXICITY AND VOLUME, SINCE STRIPPER OFF-GAS CONTAINING ORGANICS IS PASSED THROUGH AN OXIDIZER UNIT TO DESTROY THESE COMPOUNDS. NON-STRIPPABLE COMPOUNDS WOULD NOT BE DESTROYED IN THIS TREATMENT OPTION. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$5.50 MILLION.

ALTERNATIVE 3. GROUNDWATER TREATMENT BY AIR STRIPPING, WITH VAPOR PHASE CARBON (VPC) FOR THE GASEOUS EMISSIONS TREATMENT

ALTERNATIVE 3 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE DOES NOT REDUCE INHERENT COMPOUND TOXICITY, AS ORGANICS ARE MERELY CONCENTRATED ON THE CARBON FROM THE STRIPPER OFFGAS. WHEN THE PC IS STEAM REGENERATED AND THE ORGANIC PHASE DECANTED, ORGANICS ARE FURTHER CONCENTRATED. ONLY UPON INCINERATION OF THE ORGANIC DECANT OR THERMAL DESTRUCTION OF CONTAMINANTS ON THE SPENT VPA WOULD COMPOUND TOXICITY AND VOLUME BE VIRTUALLY ELIMINATED. NON-STRIPPABLE COMPOUNDS WOULD NOT BE DESTROYED IN THIS TREATMENT OPTION. SIGNIFICANT OPERATION AND MAINTENANCE (O&M) WOULD BE REQUIRED. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$6.17 MILLION.

ALTERNATIVE 4. GROUNDWATER TREATMENT BY AQUEOUS-PHASE GRANULAR ACTIVATED CARBON

ALTERNATIVE 4 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE ALSO DOES NOT BY ITSELF REDUCE INHERENT COMPOUND TOXICITY, AS ORGANICS ARE SIMPLY CONCENTRATED ON THE CARBON FROM THE GROUNDWATER. UPON THERMAL REGENERATION OF THE CARBON, THESE COMPOUNDS WOULD BE DESTROYED, THUS EFFECTING A SIGNIFICANT REDUCTION IN COMPOUND TOXICITY AND VOLUME. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT ALTERNATIVE. SIZABLE O&M WOULD BE REQUIRED DUE TO THE FREQUENCY OF CARBON CHANGE OUT, IN ADDITION TO DISPOSAL OF ANY BACKWASH SOLIDS GENERATED. SYSTEM MONITORING WOULD ALSO BE REQUIRED. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$6.30 MILLION.

ALTERNATIVE 5. GROUNDWATER TREATMENT BY AIR STRIPPING FOLLOWED BY AQUEOUS-PHASE GAC POLISHING FOR NON-STRIPPABLE COMPOUND REMOVAL

ALTERNATIVE 5 DOES NOT REDUCE INHERENT COMPOUND TOXICITY, BUT RATHER TRANSFERS A MAJORITY OF THE ORGANICS LOAD TO THE ATMOSPHERE CONCENTRATING THE REMAINING ORGANICS ONTO GAC. CONSEQUENTLY, THE VOLUME OF CONTAMINATED AIR IS INCREASED, ALTHOUGH TO A LESSER EXTENT THAN THAT PROJECTED FOR ALTERNATIVE 1. UPON

THERMAL REGENERATION OF THE CARBON, THOSE ORGANICS ADSORBED ON THE CARBON WOULD BE DESTROYED. BECAUSE ALTERNATIVE 5 EMPLOYS GAC ONLY FOR POLISHING, THE VOLUME OF ORGANICS DESTROYED IN CARBON REGENERATION, AND THE OVERALL TOXICITY REDUCTION ACHIEVED, WOULD BE LESS THAN THAT FOR ALTERNATIVE 4. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS PROCESS. THIS ALTERNATIVE IS NOT SUFFICIENTLY PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

ALTERNATIVE 6. GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH THERMAL OXIDATION, FOLLOWED BY
AQUEOUS-PHASE GAC POLISHING

ALTERNATIVE 6 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE DOES SIGNIFICANTLY REDUCE INHERENT COMPOUND TOXICITY AND VOLUME, ALTHOUGH TO A SLIGHTLY LESSER EXTENT THAN ALTERNATIVE 2. THIS IS BECAUSE THE REDUCED REMOVAL EFFICIENCY OF THE SMALLER STRIPPING SYSTEM PROPOSED WILL INCREASE THE PROPORTION OF VOLATILE ORGANICS IN ADDITION TO NON-STRIPPABLE COMPOUNDS SENT TO THE POLISHING SYSTEM, AND WILL REDUCE THE AMOUNT OF ORGANICS ROUTED TO THE THERMAL OXIDATION SYSTEM FOR EMISSIONS CONTROL. UPON THERMAL REGENERATION OF THE GAC, HOWEVER, THE VOLUME AND TOXICITY OF THE ADSORBED COMPOUNDS WOULD BE VIRTUALLY ELIMINATED. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT ALTERNATIVE. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$5.99 MILLION.

ALTERNATIVE 7. GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH VAPOR PHASE CARBON, FOLLOWED BY
AQUEOUS-PHASE GAC POLISHING

ALTERNATIVE 7 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE DOES NOT BY ITSELF SIGNIFICANTLY REDUCE INHERENT COMPOUND TOXICITY AND VOLUME, RATHER, VOLATILE COMPOUNDS WOULD GENERALLY BE TRANSFERRED VIA THE STRIPPER OFF-GAS ONTO THE VAPOR-PHASE CARBON, WHILE NON-STRIPPABLE COMPOUND WOULD BE ADSORBED ONTO THE LIQUID-PHASE CARBON. UPON STEAM REGENERATION OF THE VPC, OFFSITE INCINERATION OF THE RESULTANT ORGANIC PHASE CONDENSATE, AND OFF-SITE THERMAL REGENERATION OF GAC, AND OCCASIONALLY VPC, COMPOUND TOXICITY AND VOLUME WOULD BE SIGNIFICANTLY REDUCED. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT PROCESS. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$6.91 MILLION.

ALTERNATIVE 8. GROUNDWATER TREATMENT BY AIR STRIPPING FOLLOWED BY
UV/PEROXIDATION POLISHING FOR NON-STRIPPABLE
COMPOUND REMOVAL

ALTERNATIVE 8 IS EXPECTED TO EXCEED THE ACCEPTABLE STANDARDS FOR AIR. THIS ALTERNATIVE PROVIDES A REDUCTION IN COMPOUND TOXICITY AND VOLUME PROPORTIONAL TO THE CONCENTRATION OF CONSTITUENTS OXIDIZED IN THE POLISHING PROCESS. SINCE THE MAJORITY OF VOLATILE ORGANICS WOULD BE REMOVED BY AIR STRIPPING, WHICH DOES NOT REDUCE INHERENT COMPOUND TOXICITY, ONLY A SMALL OVERALL DECREASE IN COMPOUND TOXICITY WOULD BE REALIZED. THE INHERENT VOLUME OF CONTAMINANTS WOULD ONLY BE REDUCED BY THAT PROPORTION BEING CHEMICALLY OXIDIZED. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT ALTERNATIVE. THIS ALTERNATIVE IS NOT SUFFICIENTLY PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT.

ALTERNATIVE 9. GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH THERMAL OXIDATION FOLLOWED BY
UV/PEROXIDATION POLISHING

ALTERNATIVE 9 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE WOULD SIGNIFICANTLY REDUCE BOTH COMPOUND TOXICITY AND VOLUME VIA OXIDATION OF STRIPPED. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT OPTION. THE PRESENT ESTIMATE WORTH OF THIS ALTERNATIVE IS \$6.19 MILLION.

ALTERNATIVE 10. GROUNDWATER TREATMENT BY AIR STRIPPING IN
CONJUNCTION WITH VAPOR-PHASE CARBON FOLLOWED BY
UV/PEROXIDATION POLISHING

ALTERNATIVE 10 IS IN COMPLIANCE WITH BOTH AIR AND WATER RISK-BASED STANDARDS. THIS ALTERNATIVE WOULD IN ITSELF PROVIDE A REDUCTION IN COMPOUND TOXICITY AND VOLUME PROPORTIONAL TO THE CONCENTRATION OF CONSTITUENTS OXIDIZED IN THE POLISHING STEP. SINCE THE MAJORITY OF VOLATILE ORGANICS WOULD BE REMOVED BY AIR STRIPPING ONTO VAPOR-PHASE CARBON, WHICH DOES NOT DESTROY COMPOUND TOXICITY, ONLY A SMALL OVERALL DECREASE IN COMPOUND TOXICITY WOULD BE EFFECTED. THE VOLUME OF CONTAMINATED GROUNDWATER BE GREATLY REDUCED, ALTHOUGH THE INHERENT VOLUME OF CONTAMINANTS WOULD ONLY BE REDUCED BY THAT FRACTION BEING CHEMICALLY OXIDIZED. UPON STEAM REGENERATION OF THE VPC AND OFF-SITE THERMAL TREATMENT OF THE DESORBED ORGANIC PHASE CONDENSATE OR

THERMAL REGENERATION OF SPENT VPC, A SIZEABLE REDUCTION IN COMPOUND TOXICITY AND VOLUME WOULD BE ACHIEVED. NON-STRIPPABLE COMPOUNDS WOULD GENERALLY BE REMOVED IN THIS TREATMENT PROCESS. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$7.11 MILLION.

ALTERNATIVE 11. STEAM STRIPPING AND VAPOR-PHASE CARBON ADSORPTION
ON CONDENSER VENT STACK

ALTERNATIVE 11 ACHIEVES THE ARARS; PROTECTS HEALTH AND SAFETY DURING LONG-TERM OPERATION; ELIMINATES MOBILITY BY SEPARATING THE ORGANIC COMPOUNDS FROM THE WATER, CONCENTRATE THE ORGANIC COMPOUNDS INTO A PHASE PRODUCT, AND EITHER RECYCLES THE ORGANIC COMPOUNDS, OR DESTROY THEM BY INCINERATION; HAS A TRACK RECORD OF PROVEN PERFORMANCE; PRESENTS VIRTUALLY NO RISK OF REMEDY REPLACEMENT; AND HAS RELATIVELY LOW OPERATION AND MAINTENANCE REQUIREMENTS. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$5.57 MILLION.

ALTERNATIVE 12. STEAM STRIPPING AND VAPOR-PHASE CARBON ADSORPTION
ON CONDENSER VENT STACK AND LIQUID HOSE CARBON
ADSORPTION FOR UNSTRIPPABLE ORGANIC COMPOUNDS

ALTERNATIVE 12 ACHIEVES THE ARARS; PROTECTS HEALTH AND SAFETY DURING LONG-TERM OPERATION; ELIMINATES MOBILITY BY SEPARATING THE ORGANIC COMPOUNDS FROM THE WATER, CONCENTRATES THE ORGANIC COMPOUNDS INTO A PHASE PRODUCT AND EITHER RECYCLE THE ORGANIC COMPOUNDS, OR DESTROY THEM BY INCINERATION; HAS A TRACK RECORD OF PROVEN PERFORMANCE; PRESENTS VIRTUALLY NO RISK OF REMEDY REPLACEMENT; AND HAS RELATIVELY LOW OPERATION AND MAINTENANCE REQUIREMENTS. THE ESTIMATED PRESENT WORTH OF THIS ALTERNATIVE IS \$5.89 MILLION.

B. NO REMEDIATION ALTERNATIVE - OPERABLE UNIT 2 THROUGH 5

1. OPERABLE UNIT 2 - HILLSIDE AREA

THE TOTAL VOLUME OF CONTAMINATED SOIL IN THE HILLSIDE AREA IS MINIMAL, WITH DEPTH TO BEDROCK USUALLY BEING ONE OR TWO FEET AND WITH EXPOSED BEDROCK PRESENT IN MUCH OF THE AREA. COMPOUNDS DETECTED IN THE FORMER LAGOONS WERE DETECTED AT TRACE LEVELS IN SEVERAL OF THE SAMPLES COLLECTED IN THIS ARE. THIS INDICATES THAT OVERLAND FLOW AND/OR SHALLOW GROUNDWATER DISCHARGE FROM THE FRACTURED BEDROCK OUTCROP IN THIS AREA OCCURRED DURING OPERATION OF THE LAGOONS. CONTAMINANT LEVELS WOULD DECREASE OVER TIME IN THIS AREA BY LEACHING OF THE SOILS FROM PRECIPITATION PASSING INTO THE INTERCEPTOR TRENCH OF THE SEEP WATER COLLECTION AND TREATMENT SYSTEM, AND MOST IMPORTANTLY BY THE VACUUM EXTRACTION SOURCE CONTROL BEING IMPLEMENTED AT THE ON-SITE OPERABLE UNIT.

2. OPERABLE UNIT 3 - RAILROAD AREA

THE RAILROAD AREA CONSIST OF A SWITCHING YARD PRESENTLY IN ACTIVE USE. A WIDE VARIETY OF ORGANIC AND INORGANIC COMPOUNDS WAS FOUND THROUGHOUT THIS AREA, BOTH ASSOCIATED WITH THE FORMER LAGOON AREAS AND WITH MATERIALS USED FOR THE RAILROAD BALLAST, RAILROAD CONSTRUCTION, AND TRANSPORT OF MATERIALS BY THE RAILROAD. HOWEVER, LEVELS OF CONTAMINANTS FOUND WERE BELOW EPA'S RECOMMENDED RISK THRESHOLD AND ARE THEREFORE NOT REQUIRED TO BE REMEDIATED. FURTHER, ATTEMPTS TO REMEDIATE THIS AREA COULD CAUSE UNACCEPTABLE DISRUPTION OF FREIGHT TRANSPORT OPERATIONS.

3. OPERABLE UNIT 4 - FLOODPLAIN/WETLANDS AREA

TRACE LEVEL OF SITE-RELATED CONTAMINANTS WERE DETECTED IN THE DITCHES AND DRAINAGEWAYS RECEIVING RUNOFF FROM THE SITE. PAHS, WHICH ARE NOT SITE RELATED, ARE GENERALLY FOUND AT THE HIGHEST CONCENTRATIONS OF ALL ORGANIC COMPOUNDS DETECTED AND WITH THE GREATEST DISTRIBUTION. THE SOURCE OF THE PAHS IS MOST PROBABLY THE COAL FINES WHICH HAVE BEEN WASHED DOWNRIVER AND DEPOSITED ON THE FLOODPLAIN. NO ADVERSE EFFECTS ON ANY ORGANISMS INVESTIGATED DURING THE BIOLOGICAL STUDIES COULD BE ATTRIBUTED TO SITE-RELATED CONSTITUENTS AS LEVELS OF CONTAMINANTS WERE FOUND BELOW EPA'S RECOMMENDED RISK THRESHOLD. BECAUSE THE FLOODPLAIN IS CHARACTERIZED AS WETLANDS OVER MUCH OF ITS AREA, THE LEVELS OF CONTAMINANTS IN THE FLOODPLAIN DO NOT JUSTIFY THE EXTENT OF WETLANDS DESTRUCTION THAT WOULD NECESSARILY BE CAUSED BY REMEDIAL ACTION.

4. OPERABLE UNIT 5 - SEEP AREA

THE ORIGIN OF THE SEEP REMAINS UNKNOWN, BUT IS PROBABLY RELATED TO SHALLOW GROUNDWATER FLOW IN THIS AREA; THE SEEP HAS NOT RECURRED SINCE INITIAL RESTORATION OF THE AREA. ELEVEN OF THE SIXTEEN SAMPLES TAKEN FROM THIS AREA HAD NO DETECTABLE HAZARDOUS SUBSTANCE LIST (HSL) ORGANIC COMPOUNDS SINGLE CONCENTRATION OF HSL ORGANICS DETECTED CONSISTED OF NON-SITE RELATED PAHS. NONE OF THE CONSTITUENTS FOUND IN THE SEEP AREA EXCEEDED THE SOIL CLEANUP LEVELS SET IN THE PARTIAL CONSENT DECREE. CONSEQUENTLY, REMEDIAL EFFORTS IN THIS AREA COULD NOT

BE JUSTIFIED.

#SRA

XI. SELECTED REMEDIAL ALTERNATIVES

A. DESCRIPTION AND PERFORMANCE GOALS

SECTION 121 OF SARA AND THE CURRENT VERSION OF THE NATIONAL CONTINGENCY PLAN (NCP) (50 FED. REG. 47912, NOVEMBER 20, 1985) ESTABLISH A VARIETY OF REQUIREMENTS PERTAINING TO REMEDIAL ACTIONS UNDER CERCLA. APPLYING THE CURRENT EVALUATION CRITERIA IN TABLES 3-5, 3-6, 3-7, AND 3-8 TO THE TWELVE REMEDIAL ALTERNATIVES FOR GROUNDWATER REMEDIATION OF THE BEDROCK AQUIFER, WE RECOMMEND THAT THE FOLLOWING TREATMENT TECHNOLOGIES BE IMPLEMENTED FOR THE SELECTION OF THE PUMP AND TREAT ALTERNATIVE.

OPERABLE UNIT 1 - BEDROCK AQUIFER

THE SELECTED TECHNOLOGY IS ALTERNATIVE NUMBER 3 WITH AN OPTION TO UPGRADE TO ALTERNATIVE NUMBER 7. ALTERNATIVE NUMBER 3 INCLUDES GROUNDWATER TREATMENT BY AIR STRIPPING, WITH VAPOR-PHASE CARBON (VPC) FOR GASEOUS EMISSIONS TREATMENT. IF, DURING THE DESIGN PHASE IT IS DETERMINED THAT GAC POLISHING OF THE STRIPPED WATER IS NEEDED, ALTERNATIVE NUMBER 7, WHICH IS IDENTICAL TO NUMBER 3 PLUS GAC POLISHING, WOULD BE IMPLEMENTED.

OPERABLE UNITS 2 THROUGH 5

THE ALTERNATIVES FOR OPERABLE UNIT 2-5 ARE SELECTED BASED ON THE DISCUSSION IN SECTIONS VII AND IX. CONTAMINANTS FOUND AT OPERABLE UNITS 2, 3, AND 4 ARE BELOW DETECTABLE LEVELS AND AFFORD ADEQUATE PROTECTION TO THE PUBLIC. FURTHERMORE, CONTAMINANTS FOUND AT OPERABLE UNITS 2 AND 5 WILL STILL BE COLLECTED AND DIVERTED TO THE GROUNDWATER TREATMENT SYSTEM. ANY ATTEMPTS TO REMEDIATE OPERABLE UNITS 3 (RAILROAD AREA) COULD CAUSE UNACCEPTABLE DISRUPTIONS TO THE FREIGHT RAIL LINE. ANY ATTEMPTS TO REMEDIATE OPERABLE UNIT 4 (FLOODPLAIN/WETLANDS AREA) WOULD DESTROY LARGE PORTIONS OF THAT ENVIRONMENT, CAUSING MORE HARM THAN GOOD. ACCORDINGLY, REMEDIATION OF THE AREAS DISCUSSED ABOVE IS NOT REQUIRED.

B. STATEMENT OF FINDINGS REGARDING WETLANDS AND FLOODPLAIN MANAGEMENT

ALL EXCAVATION AND FILL ACTIVITIES DURING THE REMEDIAL ACTION SHALL BE CONDUCTED IN A MANNER CONSISTENT WITH PROVISIONS OF APPENDIX A OF 40 CFR PART 6. THE SUBJECT REGULATIONS HAVE BEEN ENTITLED "STATEMENT OF PROCEDURES ON FLOODPLAIN MANAGEMENT AND WETLAND PROTECTION." THESE PROCEDURES CONSTITUTE POLICY AND GUIDANCE FOR CARRYING OUT PROVISIONS OF EXECUTIVE ORDER 11990 RESPECTIVELY.

THE REMEDIAL DESIGN OF THE REMEDIAL ACTION SHALL BE DEVELOPED IN A MANNER CONSISTENT WITH APPENDIX A OR 40 CFR PART 6 TO ASSURE THAT POTENTIAL HARM AND ADVERSE EFFECTS TO THE WETLANDS IS MINIMIZED. THE REMEDIAL DESIGN HAS NOT YET BEEN INITIATED AT THIS TIME. THEREFORE, SPECIFIC STEPS TO MINIMIZE IMPACTS HAVE NOT YET BEEN IDENTIFIED. IN ADDITION, THE EFFECT OF THE REMEDIAL ACTION ON THE WETLANDS CANNOT ACCURATELY BE ASSESSED AT THIS TIME.

WHILE ALL REMEDIAL MEASURES SHALL BE DESIGNED TO MINIMIZE HARM TO WETLANDS, IT IS POSSIBLE THAT SOME ADVERSE EFFECTS MAY BE UNAVOIDABLE. SHOULD REMEDIAL ACTIVITY BE EXPECTED TO CREATE SUCH EFFECTS, RESTORATIVE MEASURES SHALL BE DEVELOPED DURING THE REMEDIAL DESIGN. SHOULD ANTICIPATED ADVERSE EFFECTS OCCUR, RESTORATIVE MEASURES SHALL BE IMPLEMENTED AS PART OF THE REMEDIAL ACTION.

SCHEDULE

THE ANTICIPATED SCHEDULE IS TO COMMENCE THE REMEDIAL DESIGN BY JANUARY, 1989.

#SD

XI. THE STATUTORY DETERMINATIONS

A. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

THE SELECTED REMEDY WILL REDUCE THE AMOUNT OF CONTAMINANTS DISCHARGING INTO THE SCHUYLKILL RIVER TO ACCEPTABLE LEVELS WHICH WILL ENSURE ADEQUATE PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT. NO UNACCEPTABLE SHORT-TERM RISKS OR CROSS-MEDIA IMPACT WILL BE CAUSED BY IMPLEMENTATION OF THE REMEDY.

B. ATTAINMENT OF ARARS

THE SELECTED REMEDY WILL ATTAIN THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND ARE AS FOLLOWS:

FEDERAL

CWA

* WETLANDS IMPACT

* DIFFERENTIAL GROUNDWATER POLICY

* AMBIENT WATER QUALITY CRITERIA

EXECUTIVE ORDER 11988,
PROTECTION OF FLOODPLAINS
40 CFR 6, APPENDIX A

* ACTION TO AVOID ADVERSE EFFECTS,
MINIMIZE POTENTIAL HARM, RESTORE
AND PRESERVE NATURAL AND A
BENEFICIAL VALUE

STATE

* AMBIENT AIR QUALITY GUIDELINES
FOR AIR TOXIC SUBSTANCES (ATGS)

C. COST-EFFECTIVE

THE SELECTED REMEDY FOR GROUNDWATER REMEDIATION OF OPERABLE UNIT 1 - BEDROCK AQUIFER PROVIDES OVERALL EFFECTIVENESS COMMENSURATE TO ITS COSTS SUCH THAT IT REPRESENTS A REASONABLE VALUE FOR THE MONEY.

D. UTILIZATION OF PERMANENT SOLUTIONS EMPLOYING ALTERNATIVE
TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE.

THE SELECTED REMEDY IS THE MOST APPROPRIATE SOLUTION FOR ALL OPERABLE UNITS 1 AND REPRESENTS THE MAXIMUM EXTENT TO WHICH PERMANENT SOLUTIONS AND TREATMENT CAN BE PRACTICABLY UTILIZED.

E. PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

THE PREFERENCE IS SATISFIED SINCE TREATMENT OF THE PRINCIPAL THREATS WERE FOUND TO BE PRACTICABLE.

#TA
TABLES, ATTACHMENTS

TABLE 3-1
POTENTIALLY APPLICABLE AND RELEVANT OR APROPRIATE REQUIREMENTS (ARARS)
TYSON'S SITE GROUND WATER TREATMENT

COMPOUND	AIR		PADER
	NAAQS	ATGS (UG/M3)	DISCHARGE LIMITS FOR TREATED GROUND WATER FROM THE TYSON'S SITE (UG/L)
VOLATILES			
ACETONE			
BENZENE		1.25E+01	
CHLOROBENZENE			
CHLOROFORM		4.35E+00	
1,1-DICHLOROETHANE			
1,2-DICHLOROETHANE (TOTAL)		3.85E+00	
1,2-DICHLOROPROPANE			
CIS-1,3-DICHLOROPROPENE			
ETHYLBENZENE			
METHYLENE CHLORIDE		2.42E+01	
4-METHYL-2-PENTANONE			
TETRACHLOROETHENE		1.72E+02	
TOLUENE			
TRICHLOROETHENE		7.69E+01	
1,2,3-TRICHLOROPROPANE			6.00E+02
TOTAL XYLENES			5.00E+02
SEMIVOLATILES			
ANILINE			1.00E+02
PHENOL		4.61E+02	3.00E+01
1,3-DICHLOROBENZENE			
1,4-DICHLOROBENZENE			
1,2-DICHLOROBENZENE			
NITROBENZENE			
BENZOIC ACID			
1,2,4-TRICHLOROBENZENE			
NAPHTHALENE			
DI-N-BUTYL PHTHALATE			
CRESOL			
2,4-DIMETHYLPHENOL			
N-NITROSODIPHENYLAMINE			

*TOTAL TRIHALOMETHANES
BLANKS INDICATE THAT ARARS FOR THESE COMPOUNDS ARE NOT AVAILABLE

TABLE 3-1 (CONTINUED)
POTENTIALLY APPLICABLE AND RELEVANT OR APPROPRIATE REQUIREMENTS (ARARS)
TYSON'S SITE GROUND WATER TREATMENT

SURFACE WATER

MCLS		WATER QUALITY CRITERIA			
		HUMAN HEALTH		AQUATIC LIFE	
		WATER&FISH (MG/L)	FISH ONLY (MG/L)	ACUTE (MG/L)	CHRONIC (MG/L)
VOLATILES					
ACETONE					
BENZENE	5.00E-03	6.60E-04	4.00E-02	5.30E+00	
CHLOROBENZENE		4.88E-01		2.50E-01	5.00E-02
CHLOROFORM	1.00E-01*	1.90E-04	1.57E-02	2.89E+01	1.24E+00
1,1-DICHLOROETHANE					
1,2-DICHLOROETHANE (TOTAL)					
1,2-DICHLOROPROPANE					
				2.30E+01	5.70E+00
CIS-1,3-DICHLOROPROPENE		8.70E-02	1.41E-02	6.06E+00	2.44E-01
ETHYLBENZENE		1.40E-03	3.28E-03	3.20E+01	
METHYLENE CHLORIDE					
4-METHYL-2-PENTANONE					
TETRACHLOROETHENE					
		8.00E-04	8.85E-03		
TOLUENE		1.43E+01	4.24E+02	1.75E+01	
TRICHLOROETHENE		2.70E-03	8.07E-02	4.50+01	2.19E+01
1,2,3-TRICHLOROPROPANE					
TOTAL XYLENES					
SEMIVOLATILES					
ANILINE					
PHENOL		3.50E-03		1.02E+01	2.56E+00
1,3-DICHLOROBENZENE					
1,4-DICHLOROBENZENE					
1,2-DICHLOROBENZENE					
NITROBENZENE		1.98E+01		2.70E+01	
BENZOIC ACID					
1,2,4-TRICHLOROBENZENE					
NAPHTHALENE					
					6.20E-01
DI-N-BUTYL PHTHALATE					
CRESOL					
2,4-DIMETHYLPHENOL					
N-NITROSODIPHENYLAMINE					

*TOTAL TRIHALOMETHANES

BLANKS INDICATE THAT ARARS FOR THESE COMPOUNDS ARE NOT AVAILABLE

TABLE 3-3
 TYSON'S SITE
 GROUND WATER CLEANUP LEVELS

COMPOUND	GROUND WATER CLEANUP LEVEL (1)
	MG/L
ANILINE	0.13
ANTHRACENE	7.0
BENZENE	0.00022
BENZOIC ACID	0.70
BIS (2-ETHYLHEXYL) PHTHALATE	0.051
2-BUTANONE	1.8
CHLOROBENZENE	0.06
2-CHLORONAPHTHALENE	0.11
2-CHLOROPHENOL	0.10
CHRYSENE	0.0000015
CYCLOHEPTATRIENE	0.020
CYCLOHEXANONE	23.0
DI-N-BUTYL PHTHALATE	3.5
DIOCTYLPHTHALATE	0.63
DICHLOROBENZENES	0.075
2,4-DIMETHYLPHENOL	0.28
N,N-DIMETHYL-1,3-PROPANEDIAMINE	0.65
DODECANE	3.9
ETHYLBENZENE	0.68
1-ETHYL-2-METHYLBENZENE	0.12
FLUORANTHENE	0.21
HEXADECANE	22.0
HEXADECANOICACID	0.02
METHYLENE CHLORIDE	0.0016
2-METHYLNAPHTHALENE	0.53
2-METHYLPHENOL / 4-METHYLPHENOL	1.0
4-METHYL-2-PENTANONE	1-8
N-NITROSODIPHENYLAMINE	0.0071
NAPHTHALENE	0.62
NITROBENZENE	0.018
1,1-OXYBIS (2-ETHOXYETNANE)	0.85
PHENANTHRENE	0.25
PHENOL	3.5
PYRENE	0.70
TETRACHLOROETHANE	0.00023
TETRAMETHYLUREA	0.76
TOLUENE	2.0
1,2,4-TRICHLOROBENZENE	0.23
1,3,5-TRICHLOROBONZENE	0.23
TRICHLOROETHENE	0.0011
1,2,3-TRICHLOROPROPANE	0.00035
1 2,4-TRIMETHYLBENZENE	3.0
TRIDECANE	0.41
UNDECANE	0.18
O-XYLENE	0.12

(1) CLEANUP LEVELS DERIVED TROM PARTIAL CONSENT DECREE ACCEPTABLE LEVELS

TABLE 3-3 (CONTINUED)

TYSON'S SITE
GROUNDWATER CLEANUP LEVELS

COMPOUND	GROUNDWATER CLEANUP LEVEL MG/L
1,1-DICHLOROETHANE	0.007
TRANS-1,2-DICHLOROETHENE	0.07
1,2-DICHLOROPROPANE	0.006
1,2-DICHLOROBENZENE	0.62
1,4-DICHLOROBENZENE	0.075
CHLOROFORM	0.1
CIS-1,3-DICHLOROPROPENE	0.0875

TABLE 4-4

DNAPL COMPOSITION

	WELL 3-1	WELL 8 -1
	% BY WEIGHT	
1,2,3-TRICHLOROPROPANE	23.0	73.0
XYLENES	17.0	5.8
ETHYL BENZENE	3.8	0.9
TOLUENE	4.2	0.9
	48.0% *	80.6% **

TABLE 4-18

OBSERVED RANGE OF SELECTED INORGANIC CONSTITUENTS-
FOR SOILS IN THE EASTERN U.S.

INORGANIC CONSTITUENT	OBSERVED RANGE	MEAN
ALUMINUM	0.7	
1.0%	3.3%	
ARSENIC	0.2-73 PPM	5.4 PPM
BARIUM	15-1000 PPM	300 PPM
BERYLLIUM	1-7 PPM	0.6 PPM
CADMIUM	1-1 PPM	1 PPM
CHROMIUM	1-100 PPM	36 PPM
COBALT	3-70 PPM	7 PPM
COPPER	1-150 PPM	14 PPM
IRON	0.01	
10%	1.5%	
LEAD	7-300 PPM	14 PPM
MANGANESE	2-7000 PPM	290 PPM
MERCURY	10-3400 PPB	96 PPB
NICKEL	3-700 PPM	13 PPM
SELENIUM	0.1-1.4 PPM	0.39 PPM
SILVER (WESTERN U.S.)	0.5-5 PPM	0.5 PPM
TIN	10-15 PPM	10 PPM
THALLIUM	--	--
VANADIUM	5-300 PPM	46 PPM
ZINC	5-400 PPM	36 PPM

CONNER, J.J. AND SHACKLETTE, H.T. 1975.

RESPONSIVENESS SUMMARY
FOR THE
OFF-SITE AREA
AT THE
TYSON'S DUMP SUPERFUND SITE
UPPER MERION TOWNSHIP, PENNSYLVANIA

INTRODUCTION

IN ACCORDANCE WITH THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S (EPA) COMMUNITY RELATIONS POLICY AND GUIDANCE, THE EPA REGION III OFFICE HELD A PUBLIC COMMENT PERIOD TO OBTAIN COMMENTS ON THE RECOMMENDATIONS OF THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) PREPARED FOR THE OFF-SITE AREA AT TYSON'S DUMP SUPERFUND SITE. THE OPPORTUNITY FOR A PUBLIC MEETING WAS PROVIDED, BUT NO INTEREST WAS EXPRESSED IN HAVING ONE. THE PUBLIC COMMENT PERIOD RAN FROM SEPTEMBER 4, 1988 TO SEPTEMBER 26, 1988.

THE FOLLOWING RESPONSIVENESS SUMMARY WAS PREPARED BY BOOZ, ALLEN & HAMILTON INC., A SUBCONTRACTOR TO CDM FEDERAL PROGRAMS CORPORATION, UNDER CONTRACT TO REGION III TO PROVIDE COMMUNITY RELATIONS SUPPORT. THE FIRST SECTION OF THIS DOCUMENT PROVIDES A BRIEF DESCRIPTION AND HISTORY OF THE SITE, AND THE SECOND SECTION SUMMARIZES THE COMMUNITY RELATIONS ACTIVITIES THAT HAVE RECENTLY TAKEN PLACE AT THE SITE. THE FINAL SECTION, COMMUNITY INTERESTS, SUMMARIZES THE LEVEL OF CONCERN WITHIN THE SITE COMMUNITY.

I. SITE DESCRIPTION AND HISTORY

TYSON'S DUMP SUPERFUND SITE IS LOCATED IN A DENSELY POPULATED REGION 15 MILES NORTHWEST OF PHILADELPHIA IN UPPER MERION TOWNSHIP, MONTGOMERY COUNTY, PENNSYLVANIA. THE FOUR-ACRE SITE IS BORDERED BY THE CONRAIL RAILROAD SWITCHING YARD TO THE NORTH, AN OLD QUARRY HIGHWALL TO THE SOUTH, AND THE VALLEY BROOK HOUSING DEVELOPMENT TO THE WEST. THE SCHUYLKILL RIVER IS LOCATED APPROXIMATELY 750 FEET NORTH-NORTHEAST OF THE DUMP, AND SEVERAL SMALL TRIBUTARIES FLOW INTO THE RIVER NEAR THE SITE. DOWNSTREAM OF THE DUMP, THE RIVER IS USED AS A MUNICIPAL AND INDUSTRIAL WATER SOURCE THAT SUPPLIES A NUMBER OF COMMUNITIES.

THE SITE IS AN ABANDONED SEPTIC AND CHEMICAL WASTE DISPOSAL SITE WITHIN A SANDSTONE QUARRY THAT OPERATED FROM 1962 TO 1970 UNDER THE OWNERSHIP OF FRANK TYSON AND HIS COMPANY, EAST POLLUTION TREATMENT, INC. SEVERAL FORMERLY UNLINED LAGOONS, OR PONDS, LOCATED IN THE CENTRAL AND SOUTHERN AREAS OF THE SITE, WERE USED TO STORE VARIOUS INDUSTRIAL, MUNICIPAL, AND CHEMICAL WASTES. THE DUMP WAS ALSO USED FOR THE DISPOSAL OF LIQUID SEPTIC TANK WASTES AND SLUDGES. THE DUMP SITE IS PREDOMINANTLY CONTAMINATED BY A SUSPECTED CARCINOGEN, OR CANCER-CAUSING AGENT, KNOWN AS 1,2,3-TRICHLOROPROPANE. IN ADDITION, SPILLS AND OVERFLOWS OCCURRED DURING THE EIGHT YEARS OF OPERATION, RESULTING IN THE DISPERSAL OF WASTES THROUGHOUT THE SITE. EPA IMPLEMENTED EMERGENCY MEASURES IN EARLY 1983 AND, IN SEPTEMBER 1983, THE SITE WAS PLACED ON THE NATIONAL PRIORITIES LIST (NPL), EPA'S LIST OF HAZARDOUS WASTE SITES THAT ARE ELIGIBLE FOR FEDERAL CLEANUP FUNDS.

BETWEEN JANUARY 1983 AND AUGUST 1984, EPA AND ITS CONTRACTOR CONDUCTED A REMEDIAL INVESTIGATION/ FEASIBILITY STUDY (RI/FS) IN WHAT IS NOW REFERRED TO AS THE ON-SITE AREA. THE ON-SITE AREA IS DEFINED AS THAT AREA SOUTH OF THE RAILROAD TRACKS AND WITHIN OR IMMEDIATELY ADJACENT TO THE SECURITY FENCE ERECTED DURING THE 1983 EMERGENCY RESPONSE MEASURES. THE PURPOSE OF THE RI/FS WAS TO ESTABLISH CRITERIA FOR CLEANING UP THE SITE, TO IDENTIFY AND SCREEN CLEANUP ALTERNATIVES FOR REMEDIAL ACTION, AND TO ANALYZE THE TECHNOLOGY AND COSTS OF THE ALTERNATIVES. RESULTS OF THE ON-SITE RI/FS. ALONG WITH RECOMMENDATIONS BY THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES (DER), LOCAL OFFICIALS, AND CITIZENS WERE USED BY EPA IN ITS DECISION OF A REMEDIAL ALTERNATIVE FOR THE ON-SITE PORTION OF THE SITE.

EPA SIGNED THE RECORD OF DECISION (ROD) FOR THE ON-SITE AREA ON DECEMBER 31, 1984, BUT LATER REOPENED THE ROD TO CONSIDER AN INNOVATIVE SOIL TECHNOLOGY THAT WAS NOT EVALUATED DURING THE RI/FS. THE ROD IS A PUBLIC DOCUMENT THAT EXPLAINS WHICH CLEANUP ALTERNATIVES WILL BE USED AT A NPL SITE. IN 1986, CIBA-GEIGY CORPORATION, ONE OF THE RESPONSIBLE PARTIES FOR THE SITE, CONDUCTED AN INDEPENDENT STUDY TO EXPLORE ALTERNATIVE METHODS OF CLEANUP. THIS STUDY REVEALED THAT A NEW REMEDIAL TECHNOLOGY, CALLED VACUUM EXTRACTION, WOULD BE THE MOST EFFECTIVE REMEDIAL ALTERNATIVE. BASED ON THESE FINDINGS, EPA RECOMMENDED VACUUM EXTRACTION AS THE REMEDY FOR CLEANING UP THE ON-SITE PORTION OF TYSON'S DUMP AND THIS ALTERNATIVE WAS WELL RECEIVED BY THE UPPER MERION TOWNSHIP COMMUNITY. THE REVISED ROD WAS SIGNED BY EPA ON MARCH 31, 1988.

IN THE FALL OF 1985, CIBA-GEIGY CORPORATION AGREED TO CONDUCT A FURTHER INVESTIGATION OF THE SITE AREA, THE NEED FOR WHICH WAS RECOMMENDED IN THE DECEMBER 1984 EPA ROD. THE OFF-SITE AREA IS DEFINED AS THAT AREA

OUTSIDE OF THE SECURITY FENCE INCLUDING THE DEEP AQUIFER, AN UNDERGROUND ROCK FORMATION COMPOSED OF MATERIALS SUCH AS SAND, SOIL, OR GRAVEL THAT CAN STORE AND SUPPLY GROUND WATER TO WELLS AND SPRINGS. EPA SUBDIVIDED THE OFF-SITE AREA INTO CLEANUP ACTIONS TO FOCUS ON DISTINCT AREAS OF THE OVERALL SITE. THE OFF-SITE OPERABLE UNITS INCLUDE THE FOLLOWING:

- * DEEP AQUIFER (OPERABLE UNIT 1)
- * HILLSIDE AREA (OPERABLE UNIT 2)
- * RAILROAD AREA (OPERABLE UNIT 3)
- * FLOODPLAIN/WETLANDS (OPERABLE UNIT 4)
- * SEEP AREA (OPERABLE UNIT 5).

ON MAY 27, 1986, AN ADMINISTRATIVE CONSENT ORDER (ACO) WAS SIGNED BETWEEN EPA AND CIBA-GEIGY CORPORATION FOR THE OFF-SITE OPERABLE UNIT RI/FS. THE RI/FS WAS COMPLETED AT THE END OF AUGUST 1988 AND, BASED ON THE FINDINGS OF THE STUDY, EPA PROPOSED A REMEDY FOR THE OFF-SITE AREA. THE STUDY AND EPA'S PROPOSED REMEDY WERE MADE AVAILABLE FOR PUBLIC REVIEW FROM SEPTEMBER 4, 1988 TO SEPTEMBER 26, 1988.

II. COMMUNITY RELATIONS BACKGROUND

IN MEETING ITS PUBLIC OUTREACH RESPONSIBILITIES UNDER THE SUPERFUND PROGRAM, COMMUNITY RELATIONS ACTIVITIES AT THE TYSON'S DUMP SUPERFUND SITE HAVE BEEN ONGOING. IN AUGUST AND SEPTEMBER OF 1988, A REVISED COMMUNITY RELATIONS PLAN (CRP), A FACT SHEET SUMMARIZING THE OFF-SITE REMEDIAL INVESTIGATION/ FEASIBILITY STUDY (RI/FS), AND A PROPOSED PLAN FOR THE OFF-SITE AREA WERE PREPARED. A PUBLIC NOTICE LISTING THE OFF-SITE CLEANUP ALTERNATIVES AND EPA'S PREFERRED ALTERNATIVE WAS PRINTED IN THE MORRISTOWN TIMES HERALD ON SEPTEMBER 4, 1988. ANNOUNCEMENT OF THE PUBLIC COMMENT PERIOD ALSO WAS MADE PROVIDED, BUT THE RESIDENTS EXPRESSED NO INTEREST IN HAVING ONE. THE PUBLIC COMMENT PERIOD RAN FROM SEPTEMBER 4, 1988 TO SEPTEMBER 26, 1988.

III. COMMUNITY INTERESTS

NO COMMUNITY INTEREST HAS BEEN EXPRESSED IN THE OFF-SITE AREA AT THE TYSON'S DUMP SUPERFUND SITE.

A. COMMENTS ON THE PROPOSED REMEDY.

NO WRITTEN OR ORAL COMMENTS WERE RECEIVED FROM LOCAL RESIDENTS OR OFFICIALS DURING THE PUBLIC COMMENT PERIOD. ONE COMMENT WAS RECEIVED FROM ONE OF THE POTENTIALLY RESPONSIBLE PARTIES (PRPS) CIBA-GEIGY CORPORATION. THIS COMMENT AND EPA'S RESPONSE ARE LISTED BELOW.

COMMENT: SINCE THE SUBMITTAL OF THE OFF-SITE FEASIBILITY STUDY (FS), CIBA-GEIGY HAS CONTINUED TO REVIEW POTENTIAL TREATMENT METHODS FOR GROUNDWATER AT THE TYSON'S DUMP SITE. BASED ON THIS REVIEW, CIBA-GEIGY HAS DETERMINED THAT:

- * ALTERNATIVE 3 (AIR STRIPPING WITH VAPOR PHASE CARBON) IS SAFER AND POSSIBLY SIMILAR IN COST TO ALTERNATIVE 2 (THERMAL OXIDATION)
- * ALTERNATIVE 3 IS CAPABLE OF MEETING APPLICABLE OR RELEVANT AND APPROPRIATE REGULATIONS (ARARS).

CIBA-GEIGY HAS ALSO ADDED TWO ALTERNATIVES TO THE SUMMARY OF ALTERNATIVES: STEAM STRIPPING WITH VAPOR PHASE CARBON, AND STEAM STRIPPING WITH VAPOR PHASE CARBON AND LIQUID PHASE CARBON.

EPA'S RESPONSE: AFTER CAREFUL EVALUATION OF THE ABOVE COMMENT AND FEASIBILITY STUDY, EPA HAS SELECTED A COMBINATION OF TREATMENT ALTERNATIVES WHICH DIFFERS FROM THOSE IN THE PROPOSED REMEDIAL ACTION PLAN. EPA'S SELECTED ALTERNATIVES CONSIST OF AIR STRIPPING AND STEAM STRIPPING OF GROUNDWATER WITH DIFFERENT METHODS OF FURTHER TREATING THE AIR EMISSIONS AND WATER EFFLUENT. THESE METHODS WILL BE DETERMINED DURING THE REMEDIAL DESIGN PHASE OF SITE RESPONSE.

B. REMAINING CONCERNS

SINCE ACTUAL CLEANUP PREPARATIONS BEGAN AT THE ON-SITE AREA LAST MAY, THE COMMUNITY HAS NOT VOICED ANY CONCERNS ABOUT THE ON-SITE OR OFF-SITE PORTION OF THE SITE.